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The Union Pacific is the latest great railway corporation to pass into the hands of receivers. The news of their appointment can cause little surprise when it is remembered what a large part of the company's mileage is located in the Rocky Mountain states, which have felt most severely the business depression of the past summer. The company closed last year with a surplus of about $2,000,000; but the steady decline in net earnings long ago wiped this out. The gross earnings for the first eight months of this year showed a decrease of $3,122,014 over the corresponding period last year.

The plan for removing grade crossings in Chicago on the tracks of the Pennsylvania and the Chicago & Western Indiana railways, which was prepared by the mayor's consulting engineer, Mr. Geo. H. Ellers, and noted in our issue of Oct. 5, has been rejected by a committee of the City Council. The reason for rejection was the proposal to close certain streets at the point of crossing. The Corporation Counsel has been instructed to prepare an ordinance based on Mr. Ellers' plan, but providing for a subway under the tracks at every street now opened. Action on this is to be taken at the meeting on Oct. 23.

The transportation lines in the city of Chicago carried probably over 3,000,000 passengers on "Chicago Day," Oct. 9. The following figures are given by the "Tribune" for the most important transportation lines:

South side cable system......................	757,660
North and West side cable lines..............	765,641
Illinois Central	738,329
Alley Elevated	294,986

This makes a total of 2,556,416; and the traffic on the horse and electric lines in various parts of the city with the travel on the various lines of steam railway which can be properly classed as city traffic must have made the total number of passengers carried considerably over the three million mark.

A conduit electric railway, similar to that which has operated successfully for some years in Buda-Pesth, is projected in North Chicago, and it is said that the American house of Siemens & Halske is behind the scheme, and intends to make the new line an example of what practical success can be attained by the conduit system.

The headings of the Busk-Ivanhoe tunnel, in Colorado, met last week, and through communication was established. The tunnel is 9,394 ft. long, between the towns of Busk and Ivanhoe, about 147 miles west of Colorado Springs, and its altitude above sea level is 10,810 ft. at Busk and 11,942 ft. at Ivanhoe. The section is 15 × 21 ft. The contract was let to Mr. M. H. Keefe, of Helena, Mont., in 1890, and work was commenced in that year. The rock shattered badly, rendering the work dangerous and necessitating timbering throughout. Near the Ivanhoe end a pocket of liquid mud was encountered. About 30 men have been killed during the progress of the work. The total cost will be about $1,250,000. Mr. B. H. Bryant, of Colorado Springs, Colo., is Chief Engineer. The work was described in our issue of March 30.

The authorized capital of British railways, according to the last report of the English Board of Trade, amounts to $5,265,000,000, and is increasing at the rate of about $100,000,000 per annum. The actual paid-up capital is now $4,721,000,000. The average rate of interest on this capital, taken as a whole, fell to 3.98%, as against 4.10% in the previous year, and this downward tendency has been going on since 1889.

The Simplon railway tunnel seems likely to be built, as foreign press dispatches report that a contract has been awarded for the construction of the entire work. The contract provides for the completion of a single track tunnel in five years, and the widening to double track four years later. The cost is estimated at $15,000,000 to $20,000,000. The railway will run from Brieg, in Switzerland, to Domodossola, in Italy, both of which places are railway terminals. The railway will be 30 miles long and have several tunnels and over 600 bridges.

Railway construction in Siam is progressing slowly but steadily. The bid of Mr. G. Murray Campbell, of England, to construct the Bangkok & Korat Ry. was accepted in December, 1891, and the first sod was cut by the king in March, 1892. The line will be 165 miles long, standard gage, laid with 50-lb. T rails on native hardwood ties. Tracklaying is in progress at three points, and nearly all the material has been delivered. There will be 183 bridges, with brick abutments and piers and steel superstructure. They are generally of small size, crossing the numerous canals of the Menam delta, the widest being only 180 ft. in width. About 50 miles of earthwork have been completed, this work being done by Chinese coolies and Siamese. The road is to be completed in 1896, but the line will probably be opened in sections. The meter gage line from Bangkok to Paknam, at the mouth of the river, is 14 miles long and was opened last April. The rails are English, and the locomotives and cars are of German manufacture.

The contract for the construction of the Haifa and Damascus Ry., in Syria, is reported to have been awarded to Huss & Townsend, of Chicago, who have been contractors on extensive railway works in Mexico for English companies. The road was described in our issues of May 11 and July 13, 1893. The work is to be built in sections of 25 miles and is to be completed in 18 months.

The most serious railway accident of the week was another of the numerous excursion traffic accidents which we have had to record during the past few weeks, a rear collision on the Michigan Central R. R. at Jackson, Mich., Oct. 13. The first section of an excursion train to Chicago had stopped to allow the passengers to get breakfast, and was run into by the second section, which is said to have been running at a high rate of speed, and to have run past a danger signal nearly half a mile back. The rear car was crushed in by the engine, and it telescoped the next car ahead. Twelve persons were killed, and between 30 and 40 injured, some very seriously. The usual claim is made that the air-brakes did not work, and the conductor of the second section states that when the engineman whistled for brakes he pulled the cord of the emergency valve in the toilet room of one of the cars, but found that the valve or the brakes would not work. The case is being investigated, but neither the Westinghouse Air-Brake Co. nor the Michigan Central R. R. Co. is yet able to explain the accident. The engineman's statement is to the effect that the brakes worked all right at Jackson Junction, but that when he tried to apply them at the danger signal they would not work, and that though he whistled for hand brakes there was not time to stop the train with them. Some of the press accounts state that the cock on the trainpipe at the front end of the first car of the second section was found closed.

Another serious accident of the same general nature occurred Oct. 17; the first section of the eastbound Chicago and New York limited express of the Pennsylvania R. R. coming into a side collision with a freight train at Wellsville, O. The train was being run over the Cleveland & Pittsburg R. R. between Alliance and Pittsburg on account of a freight train wreck on the Pittsburg, Fort Wayne & Chicago R. R. main line. It struck a freight train which was crossing the track in the Wellsville yards, and the passenger engine and several freight cars were wrecked. Four men were killed and three injured, all of these being trainmen. A thick fog prevailed at the time.

A flywheel 18 ft. in diameter on one of the main engines in the electric power plant of the Atlantic Ave. R. R. at Third Ave. and Second St., Brooklyn, N. Y., burst Oct. 11, the flying fragments tearing away part of the roof and walls of the building and damaging neighboring property. The wheel weighed about 20 tons. Three persons were injured.

The new hinged lift bridge carrying the New York Central R. R. over the Harlem River, in New York City became inoperative Oct. 11 owing to some of the balance weights breaking loose and getting jammed in their guides. The bridge had been opened to let a tug pass and could not be lowered, thus blocking all the traffic on this busy section of the road for some hours.

The cost of constructing the big masonry dam and canal built by the city of Austin, Tex., to furnish power for electric light and water-works plants has been $611,313, against the original estimate, based on the contractor's bid, of about $500,000. The additional cost was caused by deeper excavations for foundations than were originally intended and a consequent increase in the amount of masonry, together with the use of Portland cement for the whole structure instead of for only 2,000 cu. yds., this last item increasing the cost by 50 cts. per cu. yd. for all masonry above the 2,000 yds., or a total of $44,180. On the other hand, some of the estimates were excessive. Repairs to the break in the headgate masonry have already cost $22,000, and will cost, it is estimated, about $23,000 more. The above figures of cost of the dam, we understand, refer to the main structure, and the canal alone and not to the headgates, power-house and other accessories.

Two 1,200 HP. water-wheels have recently been completed by James Leffel & Co., of Springfield, O., for one of the paper mills to be built at Niagara Falls to utilize the enormous water-power which is being developed there by the Cataract Construction Co. The total weight of the wheel and its case is 55 tons. It is of the double horizontal type, and gear wheels and shafting will therefore be necessary to transmit the power to the surface of the ground, the wheel being set in a shaft about 125 ft. deep.

A water power and electric plant is being installed by the Moodie's Gold Mining & Exploration Co., in South Africa, as noted in our issue of March 16, for the electric transmission of power to operate the various classes of machinery used in its different mines. The plant will utilize the water power of the Queen's River, near Barberton. There are six mines on the company's claim which require power for mining and reduction purposes, and these mines are situated within a radius of four miles from the generating station. The capacity of the plant will be 500 HP., which is to be developed by four Pelton water wheels, with a capacity of upward of 125 HP. each, running under 142 ft. effective head. The minimum flow of the Queen's River is 2,300 cu. ft. per minute, and the surveyed head is 150 ft. The water is diverted from the river in the usual way by a ditch and flume, and from this flume a pipe extends down the grade a distance of 510 ft. The first third of the pipe line, which is connected to the forebay or pressure box, is 30 ins. in diameter and is made of sheet steel, No. 12 B. W. G. The next third is 28 ins. diameter and made of No. 14 steel, and the balance is 23 ins. diameter and made of No. 14 steel. The lower end of the main line terminates in a receiver which distributes the water to the several wheels. The loss of head by friction in the whole pipe line will be 8 ft., when carrying sufficient water for 500 HP. This leaves 142 ft. effective head. The pipe is double riveted in the longitudinal seams, and is of the kind extensively used in California and the Rocky Mountain mining districts. The water wheels are 6 ft. diameter and make 150 revolutions per minute. They are fed by single nozzles of the Pelton deflecting type. The nozzle tips through which the water supply is discharged are 4¼ ins. diameter and each vent 575 cu. ft. of water per minute, the combined power of the four wheels being 500 HP. The speed of the wheels is controlled by a Pelton differential governor, which operates directly upon the deflecting nozzles. The dynamos are four in number and are driven direct from the water wheel shaft by sheaves 6 ft. in diameter, each sheave grooved for five 1½-in. cotton ropes.

The Trustees of the Sanitary District of Chicago have called for proposals for excavating over 6½ million cubic yards of material on the line of the drainage canal. Bids are to be in by Nov. 29, and the full details of the call are given in another column.

The late report of Auditor Ackerman, of the Columbian World's Fair, is dated Oct. 1. To that date he reports the total expenditures of the World's Fair proper at $24,205,090. To the same date the total gate receipts were $7,404,594, and the total receipts from concessions were $2,600,307, or $10,004,901 together. Incidentally he says that the operating and construction expenses for the month of September were $870,705; the salary account alone amounting to $420,190.23 for that month.

IRON AND STEEL AT THE COLUMBIAN EXPOSITION.

It must be freely acknowledged that the exhibit of iron and steel at the Columbian Exposition falls very far short of being a complete or representative one as respects any nation, unless it is Germany, and possibly Sweden. With the exception of the Bethlehem Iron Co., which has a very creditable exhibit, the great steel-making corporations of the United States either make no exhibit at all, or make so small a one as by no means to do themselves or their country justice. The Carnegie Steel Co. and the Illinois Steel Co., our two largest steel manufacturers, have attempted nothing whatever in the way of an exhibit. The Cambria company has a very fair exhibit, though it is by no means a large one. The Pennsylvania Steel Co. has an excellent showing of the products of its frog and switch department, and also of its bridge department; but its exhibit shows nothing of its position as a great steel and iron producer. Its straitened financial condition, however, was valid reason for not spending money on an exhibit save as purely commercial reasons governed, and the same reason, doubtless, has had much to do with the general failure of iron and steelmakers to take part in the Exposition, not those of the United States only, but those of other countries as well. Certainly the German firms are entitled to much credit for their large expenditure in making exhibits here, with the prospect of pecuniary returns therefrom remote at best. Perhaps it is not too wild a guess to suppose that the entertainment given to the members of the Verein Deutscher Eisenheuttenleute on their visit to this country three years ago had something to do in inducing German iron and steelmakers to appropriate liberally for America's international exposition.

The Krupp Exhibit.

Of course, the masterpiece of the exhibition from the point of view of the iron and steelmaker is the great display of Fried. Krupp. The big guns themselves are a little disappointing. They do not look so big after all, and they go through their evolutions so quietly and smoothly that it is difficult to realize their great weight. As exhibits of metalwork, moreover, their interest is marred on account of their being painted, a criticism which must be made on very many of the iron and steel exhibits. The rough surfaces of castings, the grain of fractures and etched sections showing the structure of the metal are what interest the expert, although the bulk of the visitors to a great exposition see nothing of these things.

While the guns great and small are the central and most prominent feature of the Krupp exhibit, the products of steel and iron designed for peaceful uses are of more real interest to American engineers. The fact that the Krupp catalogue describing the articles on exhibition is a book of some 210 pages may indicate how impossible it is to do more here than mention a few of the prominent features in the exhibit. This book, by the way, as a record of what the greatest steel-producing firm in the world is able to do, is of considerable practical value. Engineers interested in iron and steelwork can probably obtain a copy by addressing Mr. A. Lauter, who is in charge of the Krupp exhibit, or Messrs. Thos. Prosser & Son, of New York city.

Great as is Krupp's reputation as a producer of war material, his armor plate appears to be inferior to that which Americans have produced by means of the Harvey process, or to that produced by the Sheffield firm of John Brown & Co., by means of the somewhat similar process invented by Captain Tressider, of the British Army. Krupp's nickel-steel plate shows remarkable toughness and high resisting power, but the exceedingly hard face produced by the Harvey or the Tressider process evidently plays an important part in crushing the point of a projectile and preventing its initial entrance.

The most remarkable piece of forging in the Krupp exhibit is probably a hollow shaft forged solid by hydraulic power from an ingot of crucible steel 8.85 ft. long and 4.1 ft. in diameter. The finished shaft is 82 ft. long, 11.81 ins. diameter outside, and is bored out for its whole length, the diameter of the hole being 4.32 ins. The shaft was bored from each end, the tools meeting at the center. The lathe on which this shaft was turned had a bed 111.5 ft. long, which could turn a shaft 16 ft. longer if necessary. The steel in this shaft has a tensile strength of 30.73 tons and shows 25.8% elongation.

In the steel castings the exhibit of most interest to Americans is a pair of frames for a Pennsylvania R. R. consolidation locomotive, which are cast in one piece from the softest and toughest grade of open-hearth steel. Is there an American steel founder who would undertake to produce such a piece and guarantee its strength and reliability to equal that of the ordinary forged iron frames? If there is one we shall be very glad to publish the fact in our columns; and we are inclined to think that the demands on our space on this account will not be heavy. But if we may judge the future by the past, our American steel founders are certain to make great and rapid advancement. The time may come, and that before very long, when even such complicated pieces of work as a locomotive frame can be cast in one piece in this country. The product will be better than the forged and welded frames, because the uncertain welds and poorer metal of the iron frame will be eliminated; and it will be cheaper, too, by reason of the saving of much expensive hand labor in the blacksmith shop. All this is in the future, however. At present, according to all reports, there is quite difficulty enough in getting a steel casting made in America of much less complicated form than a locomotive frame.

Among the rolling mill products exhibited is an open-hearth steel boiler plate 65½ ft. long, 10 ft. 10 ins. wide and 1¼ ins. thick. Such a plate would make a shell for marine boiler over 20 ft. in diameter with no circumferential seams and only one longitudinal seam, where the ends of the plate met. This plate is by no means the widest which the Krupp works are capable of producing. A boiler end plate is shown 1½ ins. thick and 12 ft. 9½ ins. in diameter. The armor plate mill on which this was made has a width of 13 ft. 1½ ins. between roll housings.

In the smaller products of iron and steel the Krupp exhibit has some wonderful examples of material and workmanship, which too many visitors have passed by unnoticed. Perhaps the most remarkable is a rolling machine for making tinsel, such as is used for making braid, lace, filagree, etc., from the finest gold and silver wires. These rolls and several similar ones for rolling precious metals, are hardened, ground and polished, and their surface shows a brilliant smoothness which defies description. We believe that for this class of work the Krupp works are acknowledged to have no superior.

The product of the Krupp establishment which is best known and most used in America is steel tires for railway use. The exhibit of this class of work is very extensive and does the firm much credit.

The Stumm Exhibit.

Few Americans had ever heard of the Stumm firm before its exhibit at Chicago; but those who have seen the beautiful display which the firm makes in the Mining Building are not likely to forget it. The remarkable feature of this exhibit is the artistic manner in which it is arranged, rather than in the actual articles exhibited, which are chiefly rolling mill products. Such a combination of real exhibition of actual products with a graceful and tasteful arrangement is seldom seen. Perhaps it is because Americans have had comparatively little experience in the arrangement of exhibits that they so often fail in producing an artistic effect; perhaps it is because Americans are still deficient in the artistic sense. In any event every American manufacturer who proposes to exhibit his goods in public may learn a valuable lesson by a study of the wonders accomplished with apparently intractable materials in the Stumm exhibit.

The Mannesmann Tubes.

No account of the foreign iron and steel exhibits would be complete which failed to describe the remarkable display of the Mannesmann Tube Works. This process, by which tubes of almost any size or thickness are rolled from a solid bar, promises to become as important commercially as it is remarkable for its ingenuity. While the main application of the invention has been to the manufacture of tubes of the ordinary commercial sizes, tubes have been made of much larger as well as much smaller diameters than we had supposed was possible by this process. Thus, a piece of wire is shown about the size of ordinary telegraph wire with a hole through its center of nearly half the outer diameter. At the other extreme is a tube 11 ins. in diameter and ½ in. thick, made for use as a cannon liner.

The company claims to be able to make tubes by this process and sell them at a profit at the same price as ordinary butt or lap welded tubes; and its continued financial success is very fair proof of the correctness of this claim. They also claim for their tubes a superior strength and resilience, due to the fact that the tubes are made without welds, and the action of the rolls disposes the fiber of the metal in spiral lines, thus giving the tube strength against longitudinal and transverse strains as well as against bursting strains. Besides the ordinary uses to which pipes and tubing are put, the Mannesmann mills are rolling hollow cylinders for making milling cutters, hollow tubing for projectile manufacture, cannon of moderate caliber and small arms, hollow shafting, wagon tongues, whiffle trees and telegraph poles. A large proportion of the tubing used by the English and American bicycle-makers is from the Mannesmann works, which is of itself an excellent proof of its quality. The Mannesmann process was described in our issue of Aug. 2, 1890.

Sweden.

The splendid exhibit of the iron and steelmakers of Sweden was probably missed by many engineers through its being located in the Swedish Building instead of in the exhibition buildings proper. Those who were so fortunate as to find it, however, had a real treat in its examination. Swedish iron has long been celebrated for its purity; and the finest English brands of crucible steel and cutlery owe no small part of their fame to the use of Swedish ores and irons. Thus, as might be expected, the Swedish exhibit is remarkable for the fine quality of the metal shown rather than for its evidence of production on a large scale. The Sandvik Iron and Steel Works show some remarkable specimens of the rolling of long strips of steel. A piece labeled "Longest steel band ever rolled hot" is 90 ft. long, 12 ins. wide, No. 6 gage, and weighs 771 lbs. Another piece, said to be the longest band ever rolled cold, is 650 ft. long, 12 ins. wide and No. 25 gage and weighs 528 lbs. The chief use of these long pieces of steel is, of course, for band saws. The same firm shows a completed band saw of No. 14 gage and 220 ft. long.

A number of the Swedish iron and steelmakers have united in an association and make a joint exhibit. Some of the steel shavings remind one of those which are turned off from the Midvale and Bethlehem steel in making guns at the Washington naval ordnance factory. One steel shaving shown here is ⅜ in. thick and 195 ft. long. Here is a "puddled steel" railway car axle which by the label upon it has run 475,358 miles, and it has then been bent cold to a radius equal to twice its diameter. Not much evidence of crystallization from service in that metal, certainly. The "Aktiebolaget Bofors Gallspang" shows a 15 cm., 35 cal., breech-loading rifle built up of cast steel. It is not many years ago that we tried in this country to make a cast steel gun in one piece and made a blank failure of it. Perhaps this Swedish success in a somewhat similar line should encourage us to try again. Here is an axe which has been tested by hacking 51 good sized notches in the edge of a ⅜-in. square iron bar. The axe shows no more injury than if it had been used on a block of wood. Here are some steel castings which have been subjected to the more scientific tests prescribed by engineers. One with 0.90 carbon shows tensile strength, 124,496 lbs. per sq. in.; elongation, 9.7%; a pretty good stretch for such hard and tenacious metal, we should call it. A softer piece with 0.60 carbon drops its tensile strength to 97,356 lbs., and raises its elongation to 15.4%. Some steel founders in this country think that 15% is a pretty fair elongation for castings made from very soft steel, with only 65,000 lbs. strength, and probably it is; but the Swedes seem to be able to do a good deal better than that.

Some very fine examples of pressed steel are shown, among which are some pressed steel shells for centrifugal cream separators which compare favorably with the fine specimens of similar work in the Krupp exhibit.

Speaking of centrifugal separators, it is a curious example of the effect of local surroundings in influencing an inventor's mind, that a Swedish inventor has worked out a centrifugal process for the treatment of steel. As many of our readers probably know, it was in Sweden that the centrifugal cream separator was first invented and brought into general use. In "setting" milk, in the process ordinarily used, the cream rises to the top by virtue of its lighter specific gravity. In the centrifugal process the milk is placed in a whirling steel bowl and the centrifugal effect exerts on each particle of the fluid a force many times as strong as the action of gravity. Thus the difference in force due to the difference of mass of the cream and the milk particles is many times as great as when gravity alone is the force acting on the particles.

In treating steel on the same principle, the effect is to force the gas bubbles to the surface as quickly as they are formed, instead of allowing them to rise slowly through the fluid metal and form blowholes in it as it cools. Of course, the molten steel cannot be run through a bowl like milk, and the method adopted by the inventor is to place 16 ingot molds, arranged in four groups of four molds each, upon a frame which is mounted on a central vertical shaft. An engine is connected to this shaft and after the molds are filled the engine is started, and the frame with the molds held in it is revolved at high speed. Each mold is hung on trunnions attached near its top, and is free to swing, so as the speed of revolution increases, the mold swings out from its original vertical position and takes up a horizontal position, its liquid contents being retained by the centrifugal force.

It is said that steel treated by this method is considerably improved over ordinary steel. The process has been used to some extent at the Nykroppa Iron Works, at Nykroppa, Sweden, and is said to have also been applied at iron works in Westphalia and Belgium. The inventor of the process is Mr. J. L. Lebenius. His American patent is dated Jan. 6, 1891. It strikes one that this is a kind of machine which it would be well to design with a pretty large factor of safety. The consequences in case one of these molds filled with molten steel should break when the machine is revolving can be imagined.

We have given more space, perhaps, to this machine than its importance absolutely warrants, but truth to tell the little model of this apparatus which is shown is one of the very few examples of the machinery of modern iron and steel production which is to be found in the whole exposition. A model of a Bessemer converter in the Stumm exhibit, and the original Kelly converter, in which the first Bessemer steel made in America was blown (which is shown by the Cambria Iron Co.) are the only other pieces of iron and steel making machinery to be found on the grounds.

England.

Very, very few of the iron and steel makers of Great Britain thought it worth while to make an exhibit at Chicago this year, and the more credit is due to the few who have gone to the trouble and expense, especially as the exhibits they make are highly meritorious. The exhibit of John Brown & Co., of Sheffield, in the Transportation Building, is probably the most interesting of the English iron and steel exhibits. The Ellis-Tressidder armor plate with its hardened steel surface is second only to the American plates treated by the Harvey process in its resisting power. The Purves steel ribbed furnaces for marine boilers and the Serve ribbed boiler tubes are foreign inventions which are gradually obtaining a foothold in this country. The Purves furnaces are shown fitted to a hydraulic flanged boiler front made from one sheet of steel and a fine specimen of workmanship. Two other articles in the exhibit which deserve mention are a forged steel crankshaft for the Russian cruiser "Rurik," and a cast steel propeller blade.

Wm. Jessop & Sons, the well known makers of high-grade tool cutlery and saw steel, have a display in the Mining Building. The exhibit of the fractures of various grades of their steels well repays examination. Some of the self-hardening steel in this exhibit shows a fracture with finer and more even grain and a more "velvety" appearance than is to be found in any other steel exhibit on the grounds. Some of the steel castings in this exhibit of considerable size have a rather rough surface and numerous blowholes, but it is possible that one's attention is called to them by their contrast with the beautifully finished surface of some of the saw plates which are shown by the same firm.

Yorkshire iron, made by the Lowmoor Iron Co., has no small reputation in this country, and the exhibit made by the company in the Mining Building is a good reminder that the very best wrought iron, made from the purest raw materials in the now rapidly disappearing puddling furnace, is a metal which in toughness and resilience has set a high mark for steelmakers to reach. But common wrought iron is far below the Lowmoor standard. If it had not been, steel would have had a harder fight to reach its present supremacy.

Other Foreign Iron and Steel Exhibits.

It has come to be generally known that little Belgium rolls steel beams for a less price per ton than any other country in the world. Several of the Belgium beam makers have exhibits in Machinery Hall. They do not show us how they are able to make their beams so cheaply, however; possibly because they do not want us to know. The Providence Iron & Steel Works shows beams cut and bent in almost every imaginable shape, apparently with the idea of showing how tough the metal is. As there is no statement whether the bending and twisting was done with the metal hot or cold, however, the visitor is likely to go away unconvinced, especially as the fractured surfaces have been painted, for the laudable object of preservation from corrosion. Samples of rail sections are exhibited by this company; but they do not harmonize well with American ideas of what a rail section ought to be. Two other Belgian firms which have exhibits similar to that of the Providence works are the "Volere Mabille" and the "Societe Anonyme des Usines du Phenix."

In the Russian section of Machinery Hall the St. Petersburg Metallic Works has an exhibit which proves that Russia can turn out some very high-class work in iron and steel. An especially noticeable specimen was a hydraulic forged wrought iron header for a water tube boiler of the Babcock & Wilcox type. In this country such headers are universally (we believe) made of cast iron. The Babcock & Wilcox Co. has a factory in Great Britain where they make forged headers, and some of these headers have recently been imported at heavy cost for a large boiler plant in New York city. This Russian firm, however, claims to make forged headers which are not only better than those of cast iron, but are less expensive, their cost being given as only 70% of that of cast iron headers.

Another specimen of metalwork which we would find it difficult to reproduce here is a corrugated boiler furnace with a Galloway tube welded in it. This Russian firm is apparently up with the times in adopting modern shop methods. The welding of these difficult pieces of work is done, we understand, with an oil burner.

The French firm of Schneider & Co., of Creusot, have become pretty well known to American engineers in the years since the design of war material for our new navy and for the re-equipment of our army became a subject of importance. The firm's exhibit in Machinery Hall is a very interesting one. These great foreign establishments seem to attempt a far greater variety of work than is common with firms in this country. Thus the Creusot works combine the building of marine and stationary engines with the production of armor plate, guns and other war material. One of the pieces exhibited is a cast steel cover for the low-pressure cylinder of "La Touraine," a disk 9 ft. 10½ ins. outside diameter and weighing 9,716 lbs. The polish on this casting indicates that French steel founders are able to make solid castings, even of so difficult a form as this.

The Schneider exhibit contains an excellent illustration of the fact that the modern gun, with the modern powder charge and projectile, is a machine for the generation and application of power quite comparable for accuracy and uniformity with such machines as the steam or gas engine. We refer to two pieces of steel plate which have been fired at with small machine guns. One plate, ¾ in. thick, has been struck by over 60 shots, each 1¼ ins. diameter. The penetration has been almost as uniform as if made by a machine tool, and though this penetration is about equal to the thickness of the plate, the back of the plate is not pierced in a single case. The metal has flowed as uniformly as if it were liquid, and on the back of the plate each point of impact is marked by a smooth "wart" about ⅜ in. high. A similar thing is to be seen on another plate, 2¾ ins. in thickness, which has been struck by about 36 shots.

Our review of the American iron and steel exhibits we shall have to defer to a following issue.

RAILWAY CONSTRUCTION IN BOLIVIA.

The central location of Bolivia has in a measure tended to retard the development of its railway systems, always a thing of slow growth in South American countries, since it has been obliged to wait until the railways of surrounding countries should approach its frontiers before extending its own lines. According to a late "Bulletin" issued by the Bureau of American Republics, the country has at present two fairly direct lines of communication with the Pacific coast. One of these is the all-rail line from Oruro, Bolivia, to the Chilean port of Antofagasta, a distance of 573 miles, and the other is the part steamer and part rail route via Lake Titicaca and the Mollendo & Puno Ry. A line from Arica, on the coast, to La Paz, 294 miles, is also partly completed, and will afford a third line much shorter than either of the others, and in the direct route of the largest traffic with the coast. Unfortunately, the engineering difficulties on the uncompleted portion of this line up the Western Cordillera are very great and its cost will be enormous.

The Antofagasta & Oruro Ry. is a narrow gage line (75 cm.) and was completed in 1892, as far as Oruro. It is intended to continue this road to La Paz, 150 miles north of Oruro. The difference in elevation between the highest and lowest points on the line is 13,087 ft. in a distance of 569 miles, or 23 ft. per mile. The grades on the Arica Ry. will be still greater. This line starts from an elevation of 1,816 ft. at Tacna, ascends to 13,863 ft. at Alto de Comanchi and then descends to 12,307 ft. at La Paz.

In addition to these several routes to the Pacific coast, the Amazon River furnishes a route north and the La Plata River south to the Atlantic seaboard. Recognizing the importance of placing the eastern part of the country, which has its own distinctive resources and trade, in direct commuication with the Atlantic Ocean, the Bolivian government has recently granted liberal concessions for the construction of railways from the interior to the navigable tributaries of the Amazon and La Plata.

These concessions embrace the following new lines of road: (1) A line from Oruro to Cochabamba and thence to Trinidad on the Mamore River, which has its outlet to the Atlantic through the Madeira and Amazon. (2) A line from La Paz through the rich province of Yungas to the head of navigation on the Beni River, which unites with the Mamore at the Bolivian port of Bella Vesta to form the Madeira River. (3) A railway from Cochabamba to Santa Cruz de la Sierra and thence to Puerto Pacheco on the Paragua River. (4) The extension of the Paragua and Bolivian standard gage railway now under construction from Asuncion, on the Paragua River, to the frontier of Bolivia and thence to be built through Bolivian territory to Sucre, the capital of the republic. (5) A railway from Uyuni on the Antofagasta line, to La Quiaca, on the Argentine frontier, to meet the proposed extension of the North Central Argentine Ry. from Jujuy. A branch is also contemplated from Uyuni to Potosi. As this road will furnish to Bolivian traffic an important and much-needed outlet to the Atlantic coast, its promoters have secured a very liberal concession from the government.

The most important of these several lines is probably the extension of the Paraguay and Bolivian standard gage line. Gen. Thos. O. Osborne, of Chicago, Ill., is the president of this road. Its route follows up the valley of the Pilcomyo through what is known as the Gran Chaco, which possesses a dry and fertile soil and a healthful climate. The

Bolivian extension passes through a rich mineral country. From Sucre it is proposed to continue the road via Oruro, La Paz and the eastern shore of Lake Titicaca to Santa Rosa, in Peru, where it is to unite with the railway system of Southern Peru, now being extended from that point to Cuzco. In connection with the line now under construction from Buenos Aires to Asuncion, this line will furnish continuous railway connection between Cuzco and Buenos Aires, a distance of about 2,000 miles. It will also be connected with the sea by the Paragua and La Plata rivers, whose waters are navigable for ocean steamers as far as Asuncion, and for river steamers several hundred miles further up.

SOME HEAVY FOUNDRY LADLES.

We illustrate herewith some recent designs for foundry ladles of large capacity. Fig. 1 shows a ladle built by Byram & Co., of Detroit, Mich., for use with a crane. The pinion which meshes with the gear wheel on the trunnion shaft is revolved by a worm gear which holds the ladle in any position without the use of a brake. The worm gear is far enough to one side to be comfortably worked, and it is inclosed to protect the lubricant from being burned off by the radiation from the hot metal.

Our second illustration shows a very peculiar ladle tipping gear just brought out by the C. W. Hunt Co. for use with special ladle cars designed to run on the tracks of the Hunt narrow gage railways. As the ladle had to tip to either side, a worm shaft at right angles to the trunnion shaft was not feasible, and it would have also been in the way in running the ladle car through doorways, or past obstacles. What was wanted was a gear mounted on a shaft parallel to the track which should still hold the ladle in any position without the use of brakes, as a worm gear does. The novelty of the design finally adopted may be judged from the fact that the two parallel shafts, seen in the engraving, rotate in the same direction, and the upper shaft cannot be turned backward by the lower. We hope to give drawings of this ingenious gearing later; but its general action may be explained by stating that projecting pins on the face of the driven wheel move in grooves between cams on the face of the driving wheel.

The rubbing surface of this gear is, of course, considerable; and it is so close to the ladle that the lubricant is apt to burn off. The expedient has been adopted, therefore, of inclosing the whole gear in a tight case, which is filled nearly full of flake graphite. This method of lubrication has worked perfectly and has the advantage of requiring no attention whatever.

Another form of special ladle car for use with ordinary flat bottom ladles, and intended for the Hunt system of narrow gage shop railways is shown in Fig. 3.

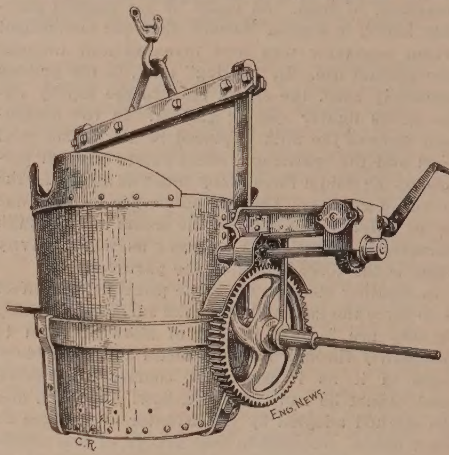

Fig. 1. Heavy Ladle for Use With Crane. Byram & Co., Detroit, Mich.

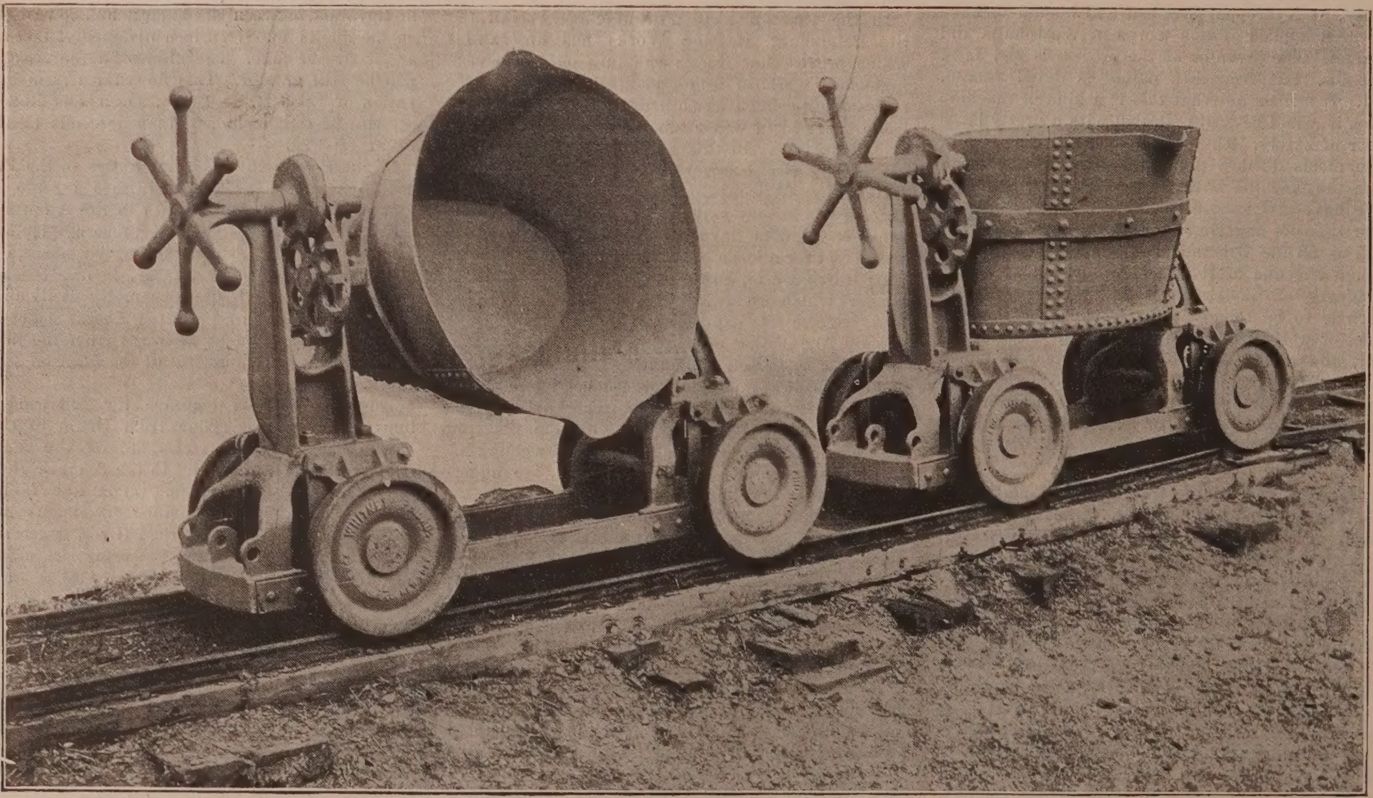

FIG. 2. LADLE CAR WITH CAM GEAR FOR TIPPING. C. W. Hunt Co.

RAILWAY TRACK EQUIPMENT AT THE WORLD'S COLUMBIAN EXPOSITION.

Owing to delay in the mails some additions intended for the article on the track equipment exhibits, published in our issue of Sept. 14, were received too late for insertion in that issue, and we, therefore, publish them separately, referring our readers to the article above mentioned.

Signals.—The 40-lever interlocking machine exhibited by the Johnson Railway Signal Co., of Rahway, N. J., was taken out from Auburn Junction, Chicago, on the Chicago & Western Indiana R. R., after 12 months' service, to make room for a 56-lever machine. This junction has 305 train movements daily, exclusive of numerous switching movements. The Wuerpel Switch & Signal Co., of St. Louis, Mo., has put in an extensive plant at the Exposition terminal station (which plant, however, is not now in use), and has adopted yellow with a black band as the color for the running face of the semaphore blades. In the Long electric semaphore exhibited by the Pennsylvania Steel Co., of Steelton, Pa., the current is generated by the signalman for each operation by means of a magneto-electric generator having no commutator and requiring only six or seven turns of the crank to produce sufficient electricity to operate the signal by means of an electric motor geared to the shaft or spindle of the semaphore blade. It is reliable and is easily operated, and signals can be operated at a considerable distance.

The Electric Selector & Signal Co., of New York, exhibits two Koyl semaphores connected with the company's apparatus intended for independent block sections, such as for tunnels, etc. The levers at each end of the section are electrically interlocked so that the operator at one end (A) cannot lower his signal blade until the operator at the other end (B) has plunged to unlock A's lever. But B cannot plunge unless his own semaphore is at danger. Thus, one signal cannot be lowered to indicate "track clear" unless the other signal indicates "track blocked." This system is in use on the Chesapeake & Ohio Ry. for working traffic through tunnels. The company also exhibits the Leonard selective train order signal, which is controlled by the train dispatcher or the operator, and has an automatic verifying answer-back. This system consists of a simple locking device attached to the train order signal, and controlled by a magnet which is energized through a selector. The selectors are not in the main line circuit, but are in the local circuit of the relay, thus adding no resistance to the line. All are operated as desired direct from the dispatcher's office. If the operator wishes to set his signal, or take it off, he does so in the usual manner. But if the dispatcher does not raise the operator when required, he can release the signal himself, by sending automatically over the line the combination, which causes the selector at the desired station to energize the locking magnet and send the signal to "stop." Every change of position in the signal is registered automatically at the dispatcher's office, whether the signal be changed by himself or by the operator, and the

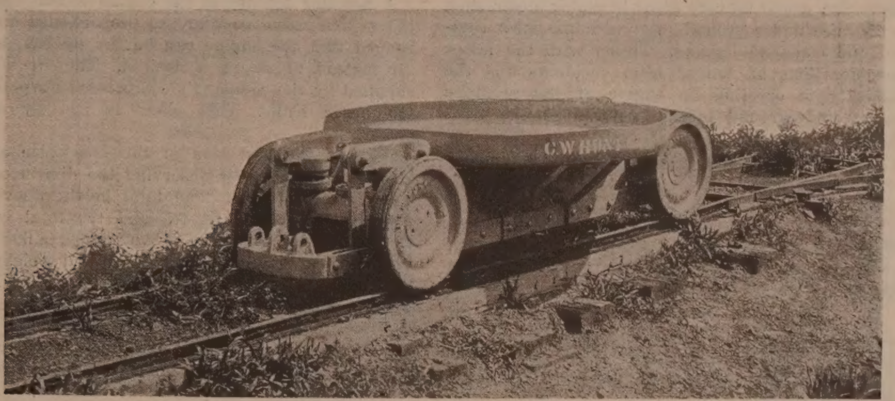

FIG. 3. CAR FOR CARRYING LADLE TO CRANE. C. W. Hunt Co.

dispatcher is, therefore, kept constantly advised of the movement of every train order signal on his division. Whenever the dispatcher sets the signal, an alarm bell is started at the signal station to call the operator to his desk for orders, and this rings until shut off by the operator. The signal remains locked in the "stop" position until the dispatcher again sends the combination over the wire releasing the armature of the locking magnet, thus preventing the operator from placing the signal at safety until the order is complete. The operation of the signal does not affect the regular service of the train dispatcher's wire, and there is no danger of the signals being set by accident, by the crossing or swinging of wires, or other accidental impulses, for each signal is controlled by its own selector, and no selector can be operated except by its own especial "combination" of impulses. This system has been applied satisfactorily for interlocking purposes, where it is desired to have but one system of signals at the station. It makes both operators responsible for the train on the block. The system appears to be a most desirable one for roads operating heavy traffic by the train dispatcher system, and its use might have prevented the recent collision on the Pittsburg, Cincinnati, Chicago & St. Louis R. R. at Chicago. The Koyl parabolic semaphore exhibited in connection with the Leonard blocking apparatus (above described) is a specialty of the National Switch & Signal Co., of Easton, Pa., and has an illuminated blade.

In the electric block system of Siemens & Halske, of New York, the operations are effected by crank handles instead of by levers as in general practice. The London & Northwestern Ry. has a complete interlocking plant, with vertical locking machine. Max Judel & Co., of Braunschweig, Germany, have a model of an electric interlocking plant at a single track junction, using the German patterns of semaphore and disk signals. The signals and switches are operated by return wires, and the locking motion is effected by a cam pulley. One disadvantageous feature is that a certain locking movement is effected by a tripping lever on the last car, thus requiring a special fitting to each train. A rather clumsy arrangement of pulleys and counterweights is used to take up the slack of the wire, acting as a compensator for temperature and also throwing the signal to danger in case of a wire breaking. In the event of a train trailing through a closed switch the signalman is automatically warned by a red disk appearing at the side of the switch lever, showing that the wire connections have been separated and must be coupled up again before operations can be resumed.

Grade Crossing Alarm.—The Pennsylvania Steel Co., of Steelton, Pa., exhibits its magneto-alarm signals for crossings. The gong is rung by magneto-electric generators, placed on each side of the crossing, in which the revolutions of the Siemens armature are produced by a flywheel train of gearing actuated by the recoil of powerful springs that are compressed by the action of a track lever by each wheel of a passing train. The electricity is thus only generated when required, and there are no batteries to be attended to. This crossing alarm is not a new device, but is in extensive use on a number of railways.

Dump Cars.—The rotary dump car exhibited by the Whitman Agricultural Co., of St. Louis, Mo., has an iron ring or turntable attached to the bottom of the body and supported upon four rollers or small wheels on the car frame. The company reports a good business in these cars, which are used on construction work and for handling dirt, pottery clay, etc. The small hopper bottom dump car, for use on construction and general work, which is exhibited by the Sheffield Car Co., is a decided novelty in dump cars.

H. K. PORTER LOCOMOTIVE EXHIBIT AT THE COLUMBIAN EXPOSITION.

In previous issues we have described the locomotives exhibited by the Baldwin, Brooks, Rogers and Schenectady locomotive works, and we present this week drawings and descriptions of the five light locomotives exhibited by H. K. Porter & Co., of Pittsburg, Pa., which firm makes an exclusive specialty of light locomotives for every class of service. Its compressed air engines for mining service are not represented. The exhibit consists of a standard gage mogul engine with tender, a standard gage logging engine, contractor's engine of 3-ft. gage, a steel works engine of 3-ft. gage, and a standard gage steam motor or dummy engine for street and suburban railways. The principal dimensions of these engines are given in the accompanying table.

The boilers are of best flange steel, with best quality homogeneous open-hearth steel for the fireboxes. The horizontal seams of the boiler are double-riveted lap seams, and the circumferential seams are single-riveted. The fire hole is made by flanging and lapping the inside and outside sheets. The boilers are hand-riveted and calked with blunt tools on bevel edges. Each boiler is regularly tested to 180 lbs. per sq. in. by hot hydraulic pressure, running the engine on friction rollers, by its own steam in the shops, as a further test, using natural gas for firing up and not moving the engine from its position. The tubes are of wrought iron, lap-welded, with copper ferules at the firebox end. The piston packing of all four engines consists of cast iron rings sprung into a solid head, and all of them have valve gear of the ordinary shifting link pattern. The guides are of the single bar type, with underhung main rod connection. The guides and piston rods are of cold rolled steel, and crossheads of cast steel. The links are made of forged steel, case-hardened, and the link motion throughout is fitted with hardened steel pins and thimbles, which are removable. The link saddle is also fitted with a hardened steel thimble. Crankpins and axles are of steel. The main and parallel rods are of steel, forged solid, fitted with taper bolts, and in general almost all of the forgings are of steel, with the exception of such forgings as require welding, where best quality of iron is used. The driving boxes are usually made of cast iron, with flanged wedges and shoes; the brasses are

Dimensions of H. K. Porter & Co.'s Light Locomotives at the World's Columbian Exposition.

	Mogul Engine.	Logging Engine.	Contractor's Engine.	Steel Works Engine.	Street Railw'y Motor.
Gage	4 ft. 8½ ins.	4 ft. 8½ ins.	3 ft. 0 ins.	3 ft. 0 ins.	4 ft. 8½ ins.
Running Gear:					
Driving wheels, diam	3 " 8 "	2 " 9 "	2 " 6 "	1 " 10 "	2 " 6 "
Truck " "	2 " 2 "	1 " 8 "	....	....	1 " 6 "
Tender " "	2 " 0 "	....	....	....	....
Journals, driving axles	5 3/16 × 7 ins.	4 1/16 × 4¾ ins.	4 1/16 × 4½ ins.	2⅞ × 3¾ ins.	3 5/16 × 4¼ ins.
" truck axles	3 13/16 × 5½ "	3½ × 5½ "	3½ × 5½ "	....	3½ × 5½ "
" tender axles	3 × 5 "	....	....	....	....
" main crank pin	3½ × 4 "	2¼ × 2¾ ins.	2¼ × 2¾ ins.	1⅞ × 2½ ins.	1⅞ × 2½ ins.
Wheel Base.—Driving	12 ft. 2 ins.	4 ft. 6 ins.	5 ft. 3 ins.	4 ft.	4 ft. 8 ins.
Total engine	18 " 2 "	12 " 2½ "	5 " 3 "	4 "	8 " 9 "
" tender	12 " 4 "	....	....	....	....
" engine and tender	37 " 11½ "	....	....	....	....
C. of truck axle to c. of driver	6 " 0 "	7 ft. 8½ ins.	....	....	4 ft. 1 in.
Wheels having blind tires	Middle	....	....	....	....
Length over all	46 ft. 2½ ins.	24 ft. 4½ ins.	17 ft.	12 ft. 4 ins.	19 ft. 4 ins.
Weight in working order: on drivers	43,000 lbs.	21,000 lbs.	22,000 lbs.	10,000 lbs.	13,000 lbs.
Engine, total	51,000 "	30,000 "	22,000 "	10,000 "	20,000 "
Tender, empty	12,536 "	....	....	....	....
Cylinders	14 × 20 ins.	9 × 14 ins.	9 × 14 ins.	6 × 10 ins.	7 × 12 ins.
Distance center to center	5 ft. 8¼ "	4 ft. 9⅞ ins.	5 ft. 9¾ "	4 ft. 1½ "	4 ft. 9½ "
Piston, thickness	4 ins.	3⅝ ins.	3⅝ ins.	2½ ins.	3 ins.
Piston rod, diam	2 7/16 "	1½ "	1½ "	1¼ "	1¼ "
Connecting rod, length c. to c	5 ft. 8¼ ins.	4 ft. 9⅞ ins.	5 ft. 9¾ ins.	4 ft 1½ ins.	4 ft. 9½ ins.
Valve Gear.—Steam ports	11½ × ⅞ ins.	7⅝ × ¾ ins.	7⅝ × ¾ ins.	5 × 9/16 in.	6¼ × ⅝ in.
Exhaust ports	11½ × 1⅜ "	7⅝ × 1¼ "	7⅝ × 1¼ "	5 × ⅞ "	6¼ × 1 "
Slide valves, in. lap	1/16 in.	1/16 in.	1/16 in.	1/16 in.	1/16 in.
" " out. lap	⅛ "	5/16 "	5/16 "	¼ "	5/16 "
" " max. travel	3 5/16 ins.	2 9/16 "	2 7/64 "	1 13/16 "	2 "
" " lead	1/16 in.	5/32 "	5/32 "	5/32 "	5/32 "
Boiler.—Type	Wagon top	Straight	Straight	Straight	Straight
Diam. of barrel inside	3 ft. 2 9/16 ins.	2 ft. 7⅛ ins.	2 ft 7⅛ ins.	2 ft. ½ in.	2 ft. 4 ins.
Thickness of barrel plates	⅜ in.	5/16 in.	5/16 in.	¼ in.	¼ in.
Thickness of smokebox tube plate	7/16 "	⅜ "	⅜ "	5/16 "	5/16 "
Dome, diam. and height	22 × 25 ins.	21 × 21 ins.	21 × 17½ ins.	18 × 18 ins.	18 × 18 ins.
Height from rail to center line	5 ft.	4 ft. 2 ins.	3 ft. 11 ins.	3 ft. 6 "	3 ft. 6 "
Working steam pressure	140 lbs.	140 lbs.	140 lbs.	140 lbs.	140 lbs.
Firebox:					
Length inside	4 ft. 6¾ ins.	3 ft. ⅛ ins.	3 ft. ⅜ ins.	2 ft. 3 7/16 ins.	2 ft. 5¾ ins.
Width inside, back	3 " ⅝ "	1 " 9½ "	1 " 7⅞ "	1 " 7½ "	2 " 8 "
" " tube sheet	3 " ⅝ "	2 " 2¾ "	2 " 1 "	1 " 7½ "	2 " 2 "
Depth at front	4 " 2½ "	3 " 4⅛ "	2 " 11¾ "	2 " 5 "	2 " 8 "
Depth at back	4 " 2½ "	3 " 4⅛ "	2 " 6¾ "	1 " 11 "	2 " 2 "
Thickness of outside shell	⅜ in.	5/16 in.	5/16 in.	¼ in.	¼ in.
" inside shell	5/16 "	¼ "	¼ "	¼ "	¼ "
" crown sheet	7/16 "	....	....	....	....
" tube sheets	7/16 "	⅜ in.	⅜ in.	5/16 in.	5/16 in.
Crown stays	Open bars	Open bars	Open bars	Open bars	Radial stay
Grate area	14.5 sq. ft.	6.75 sq. ft.	5 sq. ft.	3.9 sq. ft.	5.1 sq. ft.
Grate	Rocking	Dump	Dump	Dump	Rocking
Water space, width	2¾ ins.	2¼ ins.	2¼ ins.	2 ins.	2 ins.
Tubes.—Number	100	66	69	48	48
Diam. outside	2 ins.	1¾ ins.	1¾ ins.	1½ ins.	1¾ ins.
Length over tube plates	9 ft.	7 ft. 3 ins.	5 ft. 5 ins.	3 ft. 8 ins.	4 ft.
Heating Surface:					
Tubes, exterior	470 sq. ft.	220 sq. ft.	165.0 sq. ft.	69.0 sq. ft.	75.2 sq. ft.
Firebox	71 "	36 "	29.2 "	19.1 "	20.8 "
Total with exterior tube area	541 "	256 "	194.2 "	88.1 "	96.0 "
Miscellaneous.—Exhaust nozzles	Double	Double	Double	Single	Single
Exhaust nozzle, diam	2¼ and 2½ ins.	1¾, 1 7/16, 1¼ ins.	1¾, 1 7/16, 1¼ ins.	1½ or 1⅛ ins.	1⅝ or 1¼ ins.
Smokestack, smallest diam	14 ins.	8¾ to 9 ins.	8¾ to 9 ins.	7 ins.	8 to 9 ins.
Smokestack, height from rail to top	12 ft. 2½ ins.	9 ft. 7¾ "	9 ft. 11 ins.	8 ft. 3⅝ ins.	10 ft. 7 ins.
Capacity of tank	1,600 gallons	400 gallons	300 gallons	130 gallons	200 gallons
Capacity of coal space	2,688 lbs.	1,230 lbs.	....	....	....
Brake fittings	Power	Hand	Hand	....	Eames' vacuum

usually put in in three parts for convenience in refitting boxes, where there are no machine shops. All iron castings subject to wear are made of a special hard charcoal mixture of metal, no scrap being used. The wearing brasses are also made of ingot copper and tin, and no scrap is used. The links are of sheet steel. All of this company's locomotives are built to a thorough system of standard templates and gages, made interchangeable with all engines of the same class, and a full stock of duplicate parts is kept on hand for all regular sizes, as many customers depend wholly on the builders for repairs.

The company's business is entirely confined to the manufacture of light locomotives of all gages of track, for every variety of service and of all designs, with diameter of cylinders ranging from 5 to 14 ins.; and it claims to be the only concern in the country, or in the world, exclusively manufacturing these light locomotives. Its trade extends all over the United States, and the rest of North America, including Canada, Mexico and Alaska. Porter locomotives are also well known in Central America, in almost every country in South America, and throughout the West India islands, and they are sent to the Sandwich Islands and Japan. It is said that foreign customers like these locomotives better than those built in England or on the continent, which we can readily believe, especially as many foreign builders of light locomotives are introducing American features.

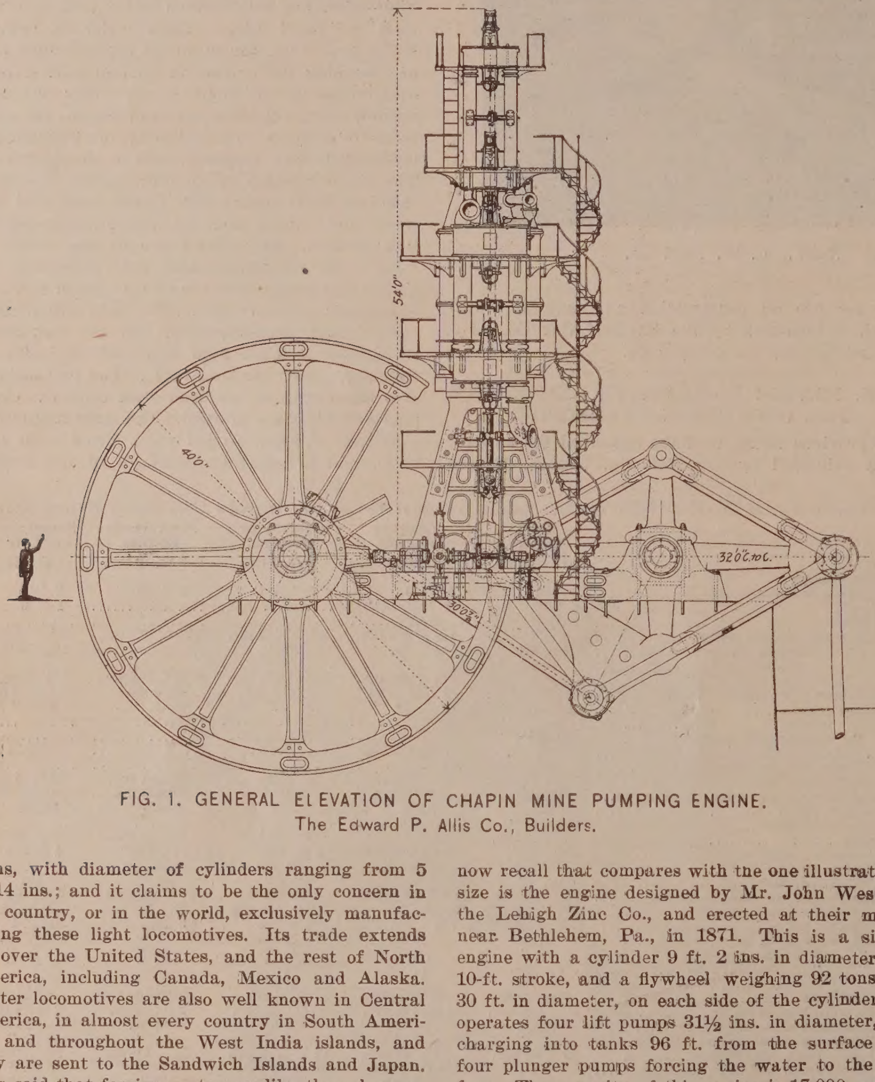

FIG. 1. GENERAL ELEVATION OF CHAPIN MINE PUMPING ENGINE.
The Edward P. Allis Co., Builders.

THE CHAPIN MINE PUMPING ENGINE.

(With inset.)

We illustrate on our inset sheet and in the accompanying cuts the general design and details of the pumping machinery built by the Edward P. Allis Co., of Milwaukee, Wis., to raise water up a vertical shaft from a depth of 1,500 ft. at the mines of the Chapin Mining Co., at Iron Mountain, Mich. The great size of the engine and the depth from which the water is to be raised make this one of the most important installations of mine drainage machinery in the United States. It is also to be noted that this is one of the few instances in this country in which the engines are located on the surface, by far the larger number being located under ground and delivering the water in a single lift.

Notwithstanding advantages of direct-acting pumping engines for most cases of mine drainage, it will be seen that the conditions here practically prohibited the use of an underground engine. An engine of sufficient power to raise water from a depth of 1,500 ft. was wanted, but at the same time it would be some years before the shaft reached this depth, and meanwhile the work at smaller depths had to be drained. Again, the condensation would be very great in piping steam such a distance under ground even with the most careful and complete lagging. These, with the lesser considerations of danger from accidents and the difficulty in erecting an engine of the requisite power underground largely determined the location of the engine.

The only other mine pumping engine which we now recall that compares with the one illustrated in size is the engine designed by Mr. John West for the Lehigh Zinc Co., and erected at their mines, near Bethlehem, Pa., in 1871. This is a simple engine with a cylinder 9 ft. 2 ins. in diameter and 10-ft. stroke, and a flywheel weighing 92 tons and 30 ft. in diameter, on each side of the cylinder. It operates four lift pumps 31½ ins. in diameter, discharging into tanks 96 ft. from the surface and four plunger pumps forcing the water to the surface. The capacity of this engine is 17,000 gallons of water per minute from a depth of 300 ft. The steam valves are balanced valves 20 ins. in diameter and with a 1¾-in. lift, and the exhaust valves are 30 ins. in diameter with a 3-in. lift. The size and weight of some of the parts are enormous. The power of the engine working under 60 lbs. pressure is 3,000 HP.

The general elevation of the Chapin mine engine and the arrangement of the pumps in the shaft are shown in Figs. 1 and 2. As will be seen, the general design of the engine is a vertical steeple compound, driving the pumps through a walking beam, motion being imparted to the crank shaft and flywheel by means of a connecting rod extending from the lower side of the beam to the crank pin. The high-pressure cylinder is 50 ins. in diameter and the low-pressure cylinder 100 ins. in diameter, and the stroke is 10 ft. Thus, the ratio of the cylinders is 1 to 4.

Both cylinders are fitted with double-beat poppet valves, the high-pressure valves being operated by trip cut-off gear, and the low-pressure valves by toes and lifters using Stevens' cut-off. The engine is designed to work with 125 lbs. pressure and at speeds varying from 5 to 10 revolutions per minute. At 10 revolutions the capacity is 3,200 gallons of water per minute from a depth of 1,500 ft. An independent steam power air pump is employed. The surface condenser uses part of the water pumped from the mine for condensing purposes. Steam is supplied by vertical tubular boilers of the Reynolds type.

A peculiar feature of the engine is that the cylinders and valve gear are so proportioned and arranged that the engine can be run by compressed air instead of steam if desired. The air will be supplied by the company's compressed air plant, at Quinnesec Falls. This plant is run by water power.

Perhaps the best idea of the great size of the engine is obtained by observing the dimensions of some of the details. The total height above the engine-room floor is 54 ft., and the total weight of the machine, exclusive of the pumps, is 600 tons. The flywheel is 40 ft. in diameter and weighs 160 tons, and the walking-beam is 32 ft. c. to c., and weighs complete 100 tons. The connecting rod is 30 ft. c. to c., and 15 ins. in diameter. The journals of the main shaft and of the beam centers are 24 ins. in diameter and 3 ft. long. The crank pin, crosshead pin and the pins of the beam have bearings 16 ins. in diameter and 18 ins. long.

The general arrangement of the pumps and the work in the shaft are shown in Fig. 2. As already stated, the final depth of the shaft will be 1,500 ft., but at present it is only about 600 ft. deep, and only three sets of pumps are now in place. The first is about 200 ft. below the surface and the others are below this and about 193 ft. apart. All three pumps are operated by a steel pump rod 7 ins. in diameter, running in adjustable bracket guides, 22 ft. apart, attached to the timbering of the shaft. Details of these guides are shown in Fig. 3. The pump rod is operated from the outer end of the walking-beam through a connecting rod 23 ft. long, to which the pump rod is joined by a crosshead running in cast iron guides. The general design of this crosshead is exactly the same as that of the pump crosshead, shown in Fig. 4. The pump rod is made up in sections 22 ft. long, which are connected by a cast steel clamp coupling, as shown in Fig. 5.

The pumps are of the ordinary "Cornish" single-acting, outside-packed plunger type, and each is fitted with a single-suction and a single-delivery valve. The plungers are 28 ins. in diameter and have a 10-ft. stroke. Details of this pump are given in Fig. 6. The valves are of the double-beat "Cornish" type, and are shown in Fig. 7. The valves have two passages for water, one of 263 sq. ins. and the other of 340 sq. ins. area, making the total area of the water passage 603 sq. ins. The lifting area is 222 sq. ins. and the lifting pressure 1.52 lbs. per sq. in. The weight of the valve in water is 340 lbs. It is interesting to note at this point that, while the general tendency in this country in designing pumping engines is toward the use of a number of small valves instead of one large valve in water ends, designers of such high reputation as Mr. Reynolds and his staff preferred in this case to use a single large valve.

Each pump stands in a wrought iron tank, or "sump," and each discharges through a 28-in. rising main into the tank of the pump above. The pumps are supported on wrought iron columns which in turn rest on heavy 30-in. girders built into the shaft, as shown in Fig. 8. The weight carried by these girders, including the thrust of the pumps, is about 100 tons for each set of pumps. The wrought iron columns are made adjustable for a sufficient height to permit keeping the pumps in line in case the girders settle.

The weight of the pump plungers, rods and connections is calculated to do half of the work on the down stroke, the remainder of the power necessary being supplied by the engine. On the up stroke the engines have, of course, to do an equal amount of work in lifting the dead weight of these various parts. In order to get the proper balance to secure this result a balance bob is placed at a point about 50 ft. above the present lower set of pumps, i. e., about 550 ft. from the surface. The general design of this balance is shown in Fig. 9 and the details of its construction in Fig. 10. The arm of this balance is 24 ft. long and is attached to the pump rod at one end and carries at the other end a counterweight of 35,000 lbs. The connection with the pump rod is made by two links which attach to a crosshead clamped to the rod.

Some comments on the general design of this plant will be found on our editorial pages.

TIMBER VS. IRON BRIDGES IN NEW SOUTH WALES.

In a report of the Parliamentary Standing Committee on Public Works, of New South Wales, on a proposed bridge, we find the following items of interest concerning the relative costs in that country of wooden, composite and iron or steel bridges:

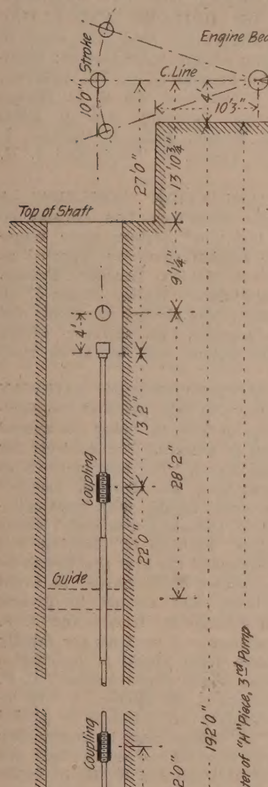

Fig. 2. Arrangement of Pumps and Pump-Rods in Shaft.

The points in question come up in the testimony of Mr. John Alexander McDonald, M, I. C. E, and M. I. M. E., then Engineer for Bridges in the Roads and Bridge Department of the New South Wales government. The bridge in controversy was the Cowra highway bridge, completed in 1870 and built entirely of timber at a cost of $45,600. It was a McCallum truss of three 130-ft. spans with simple beam span approaches. Four months after completion several of these beam spans were carried away in a flood and were replaced by three 65-ft. truss spans at a cost of $8,575. Previous to 1885 the cost of repairs on this bridge were merged in other accounts and could not be separated; but from 1885 to 1890 the average rate of repairs was $1,120 per year. In 1886 the timber piers were reported in a very unsafe condition from decay and the approach spans were also in bad condition, the only sound timbers being in the McCallum trusses. An estimate for iron piers and concrete abutments footed up to $33,750, and the renewal of approaches, widening deck and fixing footways would have cost $29,000 more, or a total of $62,750. It was then decided to get out designs for an entirely new structure.

Three designs were submitted; one for an iron lattice continuous over the three river spans; another for a composite truss, with three spans of 160 ft., and a third for an all timber bridge. These designs were carefully studied and the annual charges for renewals, etc., were tabulated, with the result that the composite plan was adopted.

All of these bridges were designed to carry 84 lbs. per sq. ft. on the 20-ft. roadway and the two 5-ft. footways; and the floor system was also designed for a traction engine weighing 16½ tons. From the cost diagram presented in the report it is seen that the capital value of the three bridges was as follows, assuming a life of 150 years for the iron and steel, 25 years for the timber trusses and 12½ years for the floors, with money borrowed at 4%:

Cheapest iron bridge	$351,375
Composite bridge	216,875
Cheapest wooden bridge	192,775

This means that the cheapest iron bridge, with a wooden floor, would exceed by 63% the cost of the composite bridge; and the capital value of the composite structure would only exceed by 13% that of the cheapest suitable all timber bridge. The annual charge for the iron bridge would be $14,055, as compared with $8,675 for the composite bridge.

In making these comparisons Mr. McDonald calls especial attention to the high cost of bridge iron delivered at highway bridge sites in New South Wales, and to the peculiar excellence of native timber for bridgework. In the composite bridge. here referred to, the bottom chord was made of steel, the suspension bolts of scrap iron, and the remainder of the superstructure was iron bark timber.

Mr. McDonald then gives the following facts bearing on the relative strength and cost of iron bark timber and iron in construction: The best iron bark has half the tensile strength of iron of the same cross-section. The weight of bridge iron is 3½ times the weight of best iron bark for equal tensile strength. The best iron bark has one-fourth the compressive strength of bridge iron for same area, and the bridge iron weighs 1⅔ times more than iron bark for same strength in compression.

Assuming iron bark erected at $1.25 per cubic foot, and bridge iron erected at $120 per ton, then—In tension a ton of iron bark, costing $37.50, is equal to 3.23 tons of bridge iron costing $377.50. In compression, a ton of iron bark costing $37.50, is equal in strength to 1.61 tons of bridge iron costing $193. These assumptions are based upon the comparative ultimate strengths of—Tension, iron bark, 11 tons; iron, 22 tons; compression, iron bark, 4½ tons; iron, 17 tons.

If these are fair samples of the prices paid for bridgework in Australia, it is not strange that the country has been near the verge of bankruptcy. There is apparently a good opportunity for the establishment of branch houses there by some of our enterprising American bridge builders. The prices named are equivalent to about 11 cts. per lb. for iron and $104 per M. for timber. It would probably be well, however, for prospective bidders to first carefully study the cost of land transportation to the site of the bridges. Mr. McDonald, in figuring upon the cost of one of the iron designs, says: "The estimated prime cost of this design complete, and including carriage which totals $37,700, will be $349,855." Nearly 11% of the total cost for transportation of material alone is a pretty severe tax, and is well worth considering in making a proposal.

PERSONALS.

Mr. George Long, of Louisville, Ky., has been elected President of the Louisville & Jeffersonville Bridge Co., to succeed his father, the late Mr. Dennis Long.

Mr. Henry W. Newby, civil engineer, of Alexandria, Va., has been appointed Special Agent of the General Land Office, Examination of Surveys, with office at Spokane, Wash.

Mr. John T. McBride, for several years Superintendent of Terminals of the Illinois Central R. R., at Chicago, has been appointed Manager of the Everett & Monte Christo R. R., with headquarters at Everett, Wash.

Mr. John Adams, General Superintendent of the Fitchburg R. R. since 1878, has resigned his position, to take effect Oct. 31. He has been connected with the road in various capacities since 1853. Mr. W. D. Ewing, Assistant General Superintendent, will take Mr. Adams' place.

NEW PUBLICATIONS.

THE SCIENCE OF MECHANICS. A Critical and Historical Exposition of the Principles. By Dr. Ernst Mach, Professor of Physics, University of Prague. Translated by Thos. J. McCormack; Chicago: Open Court Pub. Co. 12mo., pp. 534; 250 cuts; well indexed; $2.50.

Every one who has done much studying knows that there are too kinds of knowledge, broadly distinguished from each other in their utility and staying qualities. The first is what we gain from text-books or other outside sources without any individual effort or balancing of opposing conditions; the second is what we gain by our own original effort in advance of what was known before, or at least, was known to us.

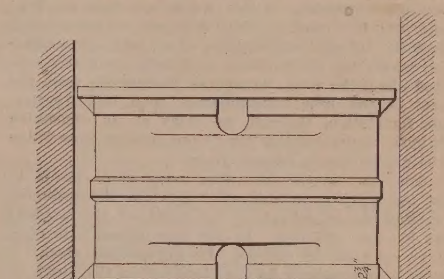

Fig. 8. Manner of Supporting Pumps in the Shaft.

The first is a most treacherous kind of knowledge, not only because it is apt to be forgotten altogether, but because it is not really assimilated; so that it is not really in the broad sense a trustworthy part of mind's working capital, even while the man has it yet in his memory. Every working engineer has had experience of this in his own career. There are certain numerous facts and principles, each of which he knows perfectly well if asked the question direct, or if he comes at it in a certain way, the way in which he learned it. But if he fetches up against it from some other direction or in some unexpected way, he is very apt to forget or overlook it until it is too late, when he is ready to kick himself for his stupidity in ever having forgotten it.

On the other hand, the knowledge that is gained by the slow process of personal experience or original investigation, though it may not be much in quantity, is apt to be vastly superior in quality. It is burnt into the mind and instantly available for any use whatsoever on which it has a bearing. Its greater availability and practical usefulness makes it the larger part of the mental working capital of every successful engineer, though it might constitute but a small part of a catalogue of all he knew.

Nevertheless, every man would find himself poorly equipped indeed for the work of life if he knew nothing but what he had dug out for himself. The greater part of his knowledge, including all his knowledge of fundamentals, must be of the kind which is merely communicated to him in already perfected form. It stands to reason, therefore, that if he is to gain this knowledge most usefully he should gain it by some mode which tends to stamp it upon the mind and make it interesting in the same way that the step by step process of original investigation does.

It is the peculiar merit of this book that for the important and fundamental subject of physics it does precisely that; and it does it by a process so simple and so effectual that it is surprising that it is not more often adopted. It simply substitutes the historical instead of the logical method of treating the subject. Each alike must necessarily proceed from the simple to the more complex, so that we do not vary the final result; but how vast is the difference between being taught the successive principles of an intricate science as so many dry abstractions, and being mentally conducted along the whole history of its growth, from the efforts of the first experimenters who laid its first crude foundation, through the story of its successive additions, to the culmination of our present knowledge in the achievements of yesterday.

It does not, as we say, take many more words to treat the subject in this way than in the ordinary way, but the effect upon the mind of the student must be very different. In the first place it teaches history as well as science. In the second place, it creates a sympathetic human interest in the story in addition to such love of science as may exist, and thus gives that great aid to the mind that any greater interest in a study always gives. Every student knows how great is the difference in his ability to comprehend a study which he is following with real interest and merely from a sense of duty.

But the greatest gain of all comes from the fact that this historical method of instruction imitates as closely as is possible the step by step process of gaining knowledge by original investigation which so stamps it upon the mind. It would be silly to waste the time of students in actually acquiring old knowledge in this way. Life is too short. But if they cannot do it for themselves they can at least follow mentally the slow and painful process of predecessors who have thus dug out their knowledge for them, and thus appreciate vastly better how great is their debt for this knowledge, how hardly it was acquired, and how necessary it was and is to any real knowledge of science.

This is the aim and this is the effect of the treatise before us. We have paid it the unusual compliment—for a reviewer—of reading it nearly all through before reviewing it. We did it, we may frankly say, because we found it interesting and instructive. The judicious mean is struck, in our judgment, between such fulness of detail as would make it tedious and unsuited as a textbook for instruction in science, and such subordination of the historical to the scientific as would make it a mere sketch interlarded with a treatise. We regard it as quite a masterly book, such as can be adopted with great advantage as part of any course in physics, and with a certainty that a better foundation will be laid for further knowledge in so doing than can be gained in a much longer time by mere abstract study of elementary principles, for which, as we say, this book is intended as a substitute.

If this be true of it as a textbook, it is still more true of it as a book for individual reading and study. To any one who feels that he does not know as much as he ought about physics we can commend it most heartily as a scholarly and able treatise which he will find both interesting and profitable; the more profitable because it is interesting, and the more interesting because it is profitable.

The one serious criticism which can be made against the book, so far as we have discovered, is that it shares the not uncommon fault of German treatises—too great a tendency to metaphysical hair-splitting. A conspicuous example occurs on the second page of the treatise proper, where, after repeating Archimedes' statement of the principle of the lever, the author continues in respect to the elementary case of a beam balanced on its center and loaded equally at its ends as follows:

> That the two weights, thus circumstanced, are in equilibrium is the assumption from which Archimedes starts. We might suppose that this was self-evident . . . . in view of the symmetry of the entire arrangement. But we forget, in this, that a great multitude of negative and positive experiences is implicitly contained in our assumption; the negative, for instance, that dissimilar colors of the lever arms, the position of the spectator, an occurrence in the vicinity, and the like, exercise no influence.

With all respect to the author, if we were to reason in this way about everything, we should never reason with any result about anything. For the soundness of all reasoning depends upon the assumption that all the premises really involved are correctly before us to begin with. When a proposition is stated to us that if such and such conditions exist it is evident (or provable) that such and such a result must ensue, it is not reasoning, but folly, to answer that we do not feel sure of this because some unstated third cause, like different colors or varying specific gravities of two arms of a beam, may also exist to modify this result. We may, indeed, claim that there is some such unstated third cause which must always exist; but otherwise all progress in knowledge would cease if we were warranted in rejecting or questioning a stated conclusion from a stated premise on the sole ground that there might be some further unstated premise which, if stated and considered, would lead to a different conclusion. This is particularly true of all reasoning as to physical laws, because they act and react upon each other so intricately that we can never assert that we have in fact considered all that may conceivably come into play. In all reasoning as to physical laws, therefore, the mere statement of certain conditions as premises excludes all logical warrant for assuming that any other modifying conditions do or can exist which are not necessarily involved in those stated.

The book would be considerably improved, especially for textbook use, by a judicious revision excluding a good many pages of this really unsound reasoning; and yet such pages are the exception, and the book, as a whole, as we have stated, is a most able and useful work. The English of the translator is a little too Germanesque, as is shown in part by the above quotation, but not very seriously so.

OBJECTS OF INTEREST TO ENGINEERS AND OTHERS IN AND ABOUT PHILADELPHIA, 1893, Compiled by and presented with the compliments of the Engineers' Club of Philadelphia. 12mo; 110 pp., with maps.

While intended originally for the use of visiting engineers during the Columbian Exposition, this is a useful reference book for anyone visiting Philadelphia. It gives in alphabetical order the public and private institutions, the bridges, manufactories, etc., of the city, with a short history of many of them. Maps of the city, on a scale of one inch to the mile, with the central part on a scale of three inches to one mile, and maps of the Pennsylvania and the Reading railway systems accompany the book.

ZYMOTIC DISEASES IN CHICAGO; Sanitary Exhibit of the Illinois State Board of Health at the World's Columbian Expostion. Pub. Doc.; Pamph., pp. 51; one diagram and many tables.

This pamphlet was prepared to accompany a number of maps, charts and diagrams illustrating the prevalence and some of the causes of zymotic or preventable diseases in Chicago during the three years 1890, 1891 and 1892. (See Eng. News, April 21, 1892, for article "Typhoid Fever in Chicago.") The contamination of the city's water supply by sewage, the effect of the highly polluted Chicago River and its branches, the density of population and the character of the "made ground" are discussed in the pamphlet and illustrated by the exhibit.

INTERNATIONAL COLUMBIAN NAVAL RENDEZVOUS AND REVIEW OF 1893 AND NAVAL MANEUVERS of 1892. Office of Naval Intelligence. General Information Series No. XII. 8vo; 238 pp. and maps.

This report gives the details of the international naval rendezvous and review of April, 1893, at Hampton Roads and New York. In the memorable parade of April 26 nine foreign nations, represented by 22 warships, were in line with 13 warships of the United States, the latter all being selected from our "new navy." The land parade of April 28 was quite as remarkable in its composition, for 3,815 officers, sailors and marines from the ships of nine nations, including the United States, marched through the streets of New York city. Following these representatives of the navies of the world marched regiment after regiment of United States and State troops.

The second section of this publication is devoted to the accounts of the naval maneuvers of 1892, of England, France, Germany and Japan. The concluding sections relate to naval administration and personnel of foreign navies; notes on warships lately launched, and notes on ordnance and small arms.

SOCIETY PROCEEDINGS.

CIVIL ENGINEERS' CLUB OF CLEVELAND.—At the meeting on Oct. 10, Mr. F. H. Richards, of Hartford, Conn., read a paper entitled, "The Cam, and Its Importance in the Modern Development of Manufactures." Mr. W. H. Searles then presented some remarks on "The Ferris Wheel."

Frank C. Osborn, Secy.

INTERNATIONAL ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS.—At the annual convention held this week in Philadelphia the following officers were elected: President, J. S. Wallace; Vice-Presidents, G. W. Andrews, W. A. McGonagle, L. K. Spofford and E. D. Hines; Secretary, S. F. Patterson; Treasurer Geo. M. Reid; Executive Committee, J. McNab, Aaron S. Markley, J. Stannard, Floyd Ingram, James H. Travis and J. H. Cumming.

INTERNATIONAL IRRIGATION CONGRESS.—A great irrigation congress opened at Los Angeles on Oct. 10. Illinois was the most eastern state represented, and among the foreign countries reported as having sent delegates are Mexico, Ecuador, France, Austria, Russia and New South Wales. Judge J. O. Emery, of Lawrence, Kan., was elected president, and Mr. F. L. Allis, of Los Angeles, Cal., secretary of the congress. Further information will be given next week.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—The next meeting will take place at the Kimball House, Atlanta, Ga., on Nov. 16, being the annual meeting for the election of officers. The subjects for discussion will be as follows: 1, "The best methods of securing cylinders, smokeboxes and frames, together with special regard to avoiding trouble with loose cylinders," R. P. C. Sanderson, Pulaski Leeds and Thomas W. Gentry. 2, "The best methods of cleaning and banking fires, and to recommend the best practice to be followed with different styles of fireboxes, to avoid troubles from leaky flues, and strains in firebox sheets," C. B. Gifford, George D. Harris and J. J. Anderson. 3, "The most improved methods for rapidly cleaning soot and cinders from inside of locomotive boiler tubes, while engines are in engine houses," C. F. Thomas, W. H. Hudson and F. H. McGee. 4, "To investigate into the advisability of complete or partial grinding of the tread of wheels cast in contracting chills with regard to the wear of the wheels and rail heads," W. H. Day, J. D. McPhail and W. H. H. Price. Messrs. Philip Wallis, T. W. Gentry, W. Hassmann and A. T. Hooker are expected to report on "Soft plugs for crown sheets of fireboxes, best form, and how to keep them effective."

S. A. Charpiot, Secy.

ENGINEERS' CLUB OF ST. LOUIS.—At the meeting on Oct. 4 Mr. E. A. Hermann read a paper on "Bracing a Tunnel in Soft Material." A tunnel 1,435 ft. long was built at North Bend, O., near Cincinnati, about 1840, for the Cincinnati & Whitewater Canal The material encountered was a mixture of river sediments containing considerable water, and causing some difficulties in construction. About 1863 the canal was abandoned, and the right of way purchased by the Cincinnati & Indianapolis R. R., now a part of the Big Four system. In March, 1884, an extraordinary flood in the Ohio River nearly filled this tunnel with water, and after it receded a short piece of the tunnel about 80 ft. long showed a deformation of its section, the side walls being slightly pressed in and the arch flattened, and this deformation threatened to increase. The difficulty was promptly remedied by the system of bracing shown on the drawings. No further movement of the walls of the tunnel took place after they were braced for the following three years, when the extension of the double track over this part of the railway necessitated either an enlargement of the tunnel or a realinement of the railway around it. The latter plan was adopted as the cheapest and most satisfactory of the two, and after its completion the track through the tunnel was abandoned. For the next meeting a paper by Mr. D. A. Moliter, on "Landslides," was announced.

Arthur Thacher, Secy.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.—The first general meeting will take place in New York city, Nov. 16 and 17, at the rooms of the American Society of Mechanical Engineers. The following is the preliminary list of papers to be read at the meeting: "Transatlantic Navigation," Chas. H. Cramp, President Wm. Cramp & Sons' Ship and Engine Building Co., Philadelphia, Pa.; "Steel Ships of the United States Navy," Theodore D. Wilson, ex-Chief Constructor, U. S. N.; "The Development of Shipbuilding on the Great Lakes," Jno. F. Pankhurst, Vice-President and General Manager Globe Iron Works, Cleveland, O.; "Notes on the Machinery of the New Vessels of the United States Navy," Geo. W. Melville, Engineer-in-Chief, U. S. Navy; "Coal Bunkers and Coaling Ships," Albert P. Niblack, Lieutenant, U. S. Navy; "Production in the United States of Heavy Steel Engine, Gun and Armor Forgings," Russell W. Davenport, Vice-President Bethlehem Iron Co., South Bethlehem, Pa.; "Determination of the Approximate Dimensions of a Vessel to Fulfill a Given Program of Requirements," Joseph J. Woodward, Naval Constructor, U. S. N.; "Comparative Performances of American and Foreign Freighting Ships—Our Superiority," Wm. W. Bates, late Commissioner of Navigation, Treasury Department; "The Wetted Surface of Ships," David W. Taylor, Naval Constructor, U. S. N.; "The Influence of Speed and Weight of Machinery on the Determination of the Other Elements of the Design of Steam Vessels," John J. O'Neill, Naval Architect and Marine Engineer; "United States Treasury Rules for the Inspection of Machinery and Boilers," Jas. T. Boyd, General Manager George F. Blake Mfg. Co.

Papers are also expected from the following gentlemen, but the exact titles have not yet been decided upon: Col. Edwin A. Stevens, President Hoboken Ferries; A. Cass Canfield, Member America's Cup Committee, New York Yacht Club; Joseph H. Linnard, Naval Constructor, U. S. N.

PUBLIC HEALTH CONGRESS.—This congress was held at Chicago Oct. 10 to 15. Among the papers of engineering interest read were the following: Mr. Allen Hazen presented a paper on "Sewage Disposal Problems in American Cities," in which he discussed chemical precipitation and land treatment. The former will often do where the stream receiving the effluent is not used for drinking purposes. Where land treatment is necessary in the New England states excellent material is often found for the purpose. The experiments of the Massachusetts State Board of Health at Lawrence may serve to a greater or less extent as a guide, but inland cities, having different materials to deal with, may need to look to foreign experience as more similar to their conditions.

In discussing the effect of habitations on tuberculosis one speaker favored the regulation by a sanitary engineer of the amount of shade in villages and another attributed the great prevalence of the disease in this country to the exclusion of light and air from dwellings.

A paper "On the Removal of Pathogenic Bacteria from Water by Sand Filtration" was read by Mr. Geo. W. Fuller, of Lawrence, Mass., who emphasized the fact that many large cities can obtain a water supply of suitable quality only by filtration.

The paper gave at some length the very successful results of experiments at Lawrence, noted from time to time in these columns, on the removal of bacteria from water, and called attention to the fact that at Lawrence the deposit on the surface of the filter beds has not been found of such great importance as has been attributed to it in Germany. In a paper by Dr. Thos. Noriega, of Mexico, the necessity of filtering potable water supplies in the United States was discussed.

A paper by Dr. A. B. Reynolds, Health Commissioner of Chicago, and Mr. Allen Hazen, showed the lowering of the Chicago typhoid fever death rate since the extension of the water tunnels further into the lake, the rate for the year ending Sept. 30, 1892, having been 6.72% of the total deaths, while for the corresponding period just ended it was only 2.64%, a decrease of 60%. The rate is still high as compared with other large cities, notably with that of London and Berlin, both of which use a polluted water supply, but not until after it has been filtered. It was suggested that engineers might well consider whether filtration or the further extensions of the intake tunnels would be the cheapest and most effective method for Chicago to pursue. Other papers described the work and methods of sanitary boards and societies in England, Japan and elsewhere.

NEW ENGLAND RAILROAD CLUB.—At the meeting on Oct. 11 the subject discussed was the use of deadblocks with M. C. B. couplers. Mr. Chamberlain (Boston & Maine) said that the deadblocks served to protect the drawbar and draft rigging from buffing shocks in switching, and in descending grades, and it was claimed that it was a safeguard to employees. He thought deadwoods were more needed with the M. C. B. bar than with the link-and-pin bar, as the former was more liable to break and was more expensive. If double deadblocks are used, there is no need of the bracket which is usually cast on the drawbar. The question of the safety of employees is a disputed one; but he thought more men were injured by the use of deadblocks than were protected by their use, and he only advocated their adoption in anticipation of the time when all the cars in the country would be equipped with the M. C. B. couplers.

Mr. Marden (Fitchburg) defended the use of deadblocks, but preferred a single buffer with a spring, similar to that used with the Miller coupler, for application to cars with the M. C. B. drawbar. It would ease the concussion of the cars and would make freight trains ride more smoothly. He believed in the buffer blocks as a safeguard to the men. Ladders between the cars are necessary, and trainmen will be up and down them, so some positive distance between the ends of cars should be maintained. The deadblocks are also economical, for they save breakage of the draft rigging and transmit the blow directly to the end sill, whereas if the coupler takes the whole blow, the draft timbers have to transmit it to the sills, and as the end of the car droops the couplers do not strike each other square.

Mr. Lauder (Old Colony) thought all other questions should be subordinated to the question of safety for the men, and it was his impression that there was more danger than safety in the use of deadblocks. It is true that deadblocks prevent the cars from coming together and crushing men when the coupler is driven back under the car; but a careful man will not stand between cars which are coming together with force enough to drive the drawbar under the car. Some of the Lackawanna cars have buffer blocks so large that they almost inclose and hide the drawbar, and it is exceedingly dangerous for the men attempting to couple them.

Mr. Packard (N. Y. C. & H. R.) thought nothing was gained on the whole by the use of deadwoods, except that they should be applied with air-brakes. The New York Central officers believed they were doing the right thing in removing the deadwoods from their cars.

Mr. Lauder called Mr. Packard's attention to the long continued success of the roads west of the Missouri in the use of air-brakes on cars equipped with ordinary link-and-pin couplers, and said that while the M. C. B. coupler was an advantage in handling air-braked trains, it was not a necessity.

Mr. Adams (Boston & Albany) had always been opposed to double deadblocks, but favored the use of single deadwoods 5½ to 7 ins. thick.

The Finance Committee was instructed to consider the matter of printing the proceedings of the club in pamphlet form. At the next meeting, on Nov. 15, the subject for discussion will be "Permanent Way and Rolling Stock, and Their Relation to Each Other."

IRON AND STEEL INSTITUTE.—(From our London Correspondent).—The annual provincial meeting was held at Darlington, Sept. 26-29. It proved to be one of the most successful of the autumn meetings ever held. The following is a list of the papers set for reading: "On the Manufacture of Basic Steel at Witkowitz," by Paul Kupelwieser; "On the Waste of Fuel, Past, Present and Future, in Smelting Ores of Iron," by Sir Lowthian Bell; "On Iron and Steel at the Chicago World's Fair," by H. Bauerman; "On Iron and Steel Wire, and the Development of Its Manufacture," by J. P. Bedson; "On the Sampling of Iron Ore," by T. Clarkson; "On the Tudhoe Works of the Weardale Iron & Coal Co., Ltd.," by W. H. Hollis; "On the Luhrig Coal Washing and Dry Separation Plant at the North Bitchburn Coal Co.'s Randolph Pit," by James I'Anson; "On Carbon in Iron," by Professor Ledebur (Freiberg); "On Suggested Improvements in Connection with the Manufacture of Steel Plates," by William Muirhead; "On the Last Twenty Years in the Cleveland Mining District," by A. L. Steavenson; "On the Production of Wrought Iron in Small Blast Furnaces in India," by T. Turner.

On the members assembling and the usual formal proceedings having been transacted, the paper by Mr. Kupelwieser was read. The author has introduced at the well known works at Witkowitz a system of steel manufacture which is a compound of the Bessemer and Siemens processes. This method has been in operation since 1890. The pig iron obtained at Witkowitz contains too much phosphorus for use in the ordinary acid Bessemer process, while it does not contain sufficient for the basic process. In order to use the material, therefore, pig iron from a blast furnace is worked in the Bessemer converter, but the oxidation is only continued till the silicon (0.8 to 1.2%) is eliminated. This will be effected in about five or six minutes. The result is a metal which is something between white iron and very hard steel. A portion of the manganese is also eliminated during the blow, but the phosphorus remains. The metal is next taken to the open hearth furnace, into which it is run through a hole low down in the side; of course, in a molten condition. As the blast furnaces are often unable to supply sufficient pig for the open-hearth furnaces, about 40% of cold pig iron is added; the conversion of the metal to mild steel is then completed by the basic process. The advantages of the system are that as the pig is desiliconized in the converter it does not attack the basic lining of the furnace, and the fact that the iron is not allowed to cool (with the exception of the 40% mentioned), and, therefore, does not require to be remelted at each stage of the process, is naturally an advantage. The author claims that the benefits derived from this method of working entirely outweigh any disadvantages there may be. Of course the Bessemer process is a cheaper method of converting pig iron into steel than the open-hearth process, and by employing the former method a saving of cost is effected, so far. Against this must be set the complication of two processes and the transference of the metal. Mr. Kupelwieser gave figures as to cost which chowed a saving in conversion of $2.50 per ton.

The next item on the program was Sir Lowthian Bell's paper, which, however, was not read, the author, in place of following his memoir, giving an extempore lecture on the subject matter of waste heat in smelting ores. He told us that 50 or 60 years ago, to produce a ton of pig iron in Scotland, 11¼ tons of coal were consumed; by the year 1830 this quantity was reduced to eight tons, and since then less than two tons of fuel have been required for the purpose in Cleveland, using the poorer mineral of that district. An interesting part of the paper referred to the utilization of the waste heat in the slag. Exhaust steam is passed over the hot slag in a chamber and is thus superheated. At Middlesborough it is proposed to use this heat to evaporate the brine from the salt works. Experiments show that a furnace producing 500 tons of pig per week may be regarded as being able to evaporate in this way a quantity of brine equal to about 150 tons of salt.

On the second day Professor Ledebur's paper, on "Carbon in Iron," and the contribution by Mr. Bedson, "On the Manufacture of Steel Wire," were read. The author of the latter paper belongs to a family of wire-makers, and is of the fourth generation. Perhaps the most salient feature in his paper was the strong preference expressed for basic steel; in fact, if we accept Mr. Bedson's authority, no other material should be used for the manufacture of steel wire, the acid produced steel being entirely out of court. From wire the meeting proceeded to plates, Mr. Muirhead's paper above noted being presented. His suggestions, however, proved to be by no means novel, in their main features, at least. Mr. Clarkson then described his apparatus for sampling iron ore, and the remaining papers on the list were taken as read. During the meeting excursions were taken to the Tudhoe Iron & Steel Works, the Randolph colliery of the Bitchburn Co., where the Luhrig system of coal washing is in operation, and the celebrated Consett Iron Works.

COMING TECHNICAL MEETINGS.

ENGINEERS' CLUB OF PHILADELPHIA.
Oct. 21. Secy., L. F. Rondinella, 1122 Girard St.
SWEDISH ENGINEERS' CLUB.
Oct. 21. Secy., P. Valentine. At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 180 La Salle St., Chicago Secy., John Ericson.
DENVER SOCIETY OF CIVIL ENGINEERS.
Oct. 23. Secy., F. E. King, Jacobson Block.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
Oct. 26. Secy., C. H. McLeod, Montreal, P. Q.
ENGINEERS' CLUB OF ST. LOUIS.
Nov. 1. Secy., Arthur Thacher, Odd Fellows' Building.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Nov. 1. Secy., F. Collingwood, 127 East 23d St., New York.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Nov. 6. Secy., C. L. Annan, City Engineer's Office.
ENGINEERS' SOCIETY OF PHŒNIXVILLE.
Nov. 7. Secy., W. Halliburton.
WESTERN SOCIETY OF ENGINEERS.
Nov. 8. Secy., Jno. W. Weston, 51 Lakeside Bldg., Chicago.
ENGINEERS' CLUB OF MINNEAPOLIS.
Nov. 9. Secy., E. Nexsen, 504 Kasota Block.
ENGINEERING ASSOCIATION OF THE SOUTH.
Nov. 9. Secy., W. G. Kirkpatrick, Nashville, Tenn.
ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
Nov. 9. Secy., F. W. Mowbray, Norton Building.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
Nov. 10. Secy., D. W. Meeker, St. Paul.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
Nov. 10. Secy., E. K. Smoot, 808 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
Nov. 10. Secy., O. Von Geldern, 719 Market St., San Francisco.
MONTANA SOCIETY OF CIVIL ENGINEERS.
Nov. 11. Secy., G. O. Foss, Helena.
ENGINEERS' CLUB OF KANSAS CITY.
Nov. 13. Secy., Waterman Stone, Baird Building.
WISCONSIN POLYTECHNIC SOCIETY.
Nov. 13. Secy., M. F. Schinke, City Hall.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
Nov. 14. Secy., F. C. Osborn, Case Library Bldg.
NORTHWEST RAILROAD CLUB.
Nov. 14. Secy., W. D. Crosman, Ryan Hotel, St. Paul.
NORTHWESTERN SOCIETY OF ENGINEERS.
Nov. 14. Secy., D. W. McMorris, Burke Block, Seattle, Wash.
CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
Nov. 15. Wichita, Kan.
NEW ENGLAND RAILROAD CLUB.
Nov. 15. Secy. F. M. Curtis, O. C. R. R., Boston.
BOSTON SOCIETY OF CIVIL ENGINEERS.
Nov. 15. Secy., S. E. Tinkham, 36 Broomfield St.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
Nov. 15. Secy., L. V. Carmalt, Roanoke, Va.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Nov 16. Secy., S. A. Charpiot, Macon, Ga.
NEW YORK RAILROAD CLUB.
Nov. 16. Annual meeting. Secy., John A. Hill, Temple Court, New York
ENGINEERS' CLUB OF CINCINNATI.
Nov. 16. Secy., J. F. Wilson, 24 W. 4th St.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
Nov. 16. Secy., Allen Strale, 100 Washington St.
TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS.
Nov. 17. 201 Washington Building.
WESTERN RAILWAY CLUB.
Nov. 21. Secy., Clement F. Street, Chicago.
COLUMBIAN ENGINEERING SOCIETY.
Nov. 21. Secy., F. W. Hart, Washington, D. C.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Nov. 21. Secy., R. H. Clark, Pittsburg.
CENTRAL RAILWAY CLUB.
Nov. 22. Secy., S. W. Spear, Buffalo, N. Y.

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AND
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D. McN. STAUFFER, A. M. WELLINGTON.....EDITORS
CHAS. W. BAKER, E. E. R. TRATMAN, M. N. BAKER, F. P. BURT, C. S. HILL } ASSOCIATE EDITORS
GEO. H. FROST..........................BUSINESS MANAGER

Chicago Office: Monadnock Building.
F. A. PECKHAM..................................MANAGER

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ADVERTISING RATES: 20 cents per line agate measure. Schedule sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements, not later than Wednesday noon. The last pages go to press early on Thursday. We shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.

The headquarters of Engineering News on the grounds of the World's Columbian Exposition are at Section K, Aisle 37, of Machinery Hall (central aisle, just west of the large water tank), and at Section U N, Posts 10 to 11 (office No. 9), of the Transportation Building Annex, at the west end of the Great Britain railway exhibit. For the convenience of subscribers and advertisers, it is announced that some member of the editorial staff of this journal may be found at the first-named office, in Machinery Hall, from 10 to 10:25 a. m., of each week day, and from 10:35 to 11 a. m. at the second-named office, in the Transportation Building; as also frequently at other times. Appointments may be made by calling at our downtown Chicago office in the Monadnock Building.

The Engineering headquarters, at Chicago, are at No. 10 Van Buren St., directly opposite the viaduct leading to the Illinois Central R. R. World's Fair trains, and to the steamboat pier, and but a stone's throw from it. The rooms are large and comfortable, and include reading, writing, smoking and other apartments. The rooms are to be kept open during the Fair by subscriptions of engineers, and all American and foreign engineers visiting Chicago are invited to register and make free use of the rooms during their stay, and to have their mail addressed there. An informal reception is held at these rooms every Monday evening from 8 to 10 p. m.

The City of Charleston has made a queer move in abolishing by ordinance the office of city engineer and in substituting for this officer a city surveyor. But why the change in title has been made is difficult to understand, as the terms of the ordinance make it a distinction without a difference, for it is an engineer of a pretty high order that the authorities demand after all. This officer is to be "a competent, scientific person, skilled in engineering, architecture and surveying"; and "all duties now devolved by law on the city civil engineer are hereby devolved upon the city surveyor." Other parts of the same ordinance show that this "city surveyor" has to provide all plans for street grading and the laying of pipes for water and gas, for all sewers and for all public works in charge of the street department. The title of city surveyor is, perhaps, the more time-honored of the two; but as the duties of that office are now strictly engineering duties, the term city engineer better expresses these duties and should be adhered to. The salary, $2,000 per annum and no fees, is the smallest thing about the proposed change, and is too small for a city of the importance of Charleston.

The summer epidemic of quite serious railway disasters which may be traced with more or less certainty to the disturbing influence of the Columbian Exposition traffic has been continued this week by two more considerable accidents of the same general class. The only real and permanent cure for such events is the universal use of the absolute block system, and that is not an infallible cure, since accidents will occur in spite of it. To what small proportions they may be reduced, however, is evidenced in a striking way by the Board of Trade returns for Great Britain, where the absolute block system is practically universal, for the first six months of 1893, which show only 1 passenger killed and 202 injured by accidents to trains, rolling stock, permanent way, etc., of all kinds whatsoever, against 11 killed and 282 injured for the corresponding period of 1892. Including railway employees the totals are respectively 6 killed and 235 injured, against 14 killed and 324 injured in 1892. These figures in themselves would prove nothing, being for so short a period, but in connection with prior returns they show that the gratifying decrease of fatal train accidents, which has continued with partial interruptions for a long period of years, as we have often shown, still continues.

Another very interesting evidence of the same fact is that the "number of train accidents inquired into," which includes all those which occur of any importance, was in 1892 the smallest on record, being only 48, against 118 in 1892 and 161 in 1875. The number of serious collisions of all kinds has decreased in the following remarkable manner for 1880 to 1892 inclusive:

71, 58, 62, 55, 53, 34, 36, 33, 30, 32, 35, 35, 22.

The year 1893, so far as the first six months can indicate, is destined to show a still better record. It must be clearly understood, however, that this record does not cover the absolute number, nor the number above a fixed standard of importance, but only those which it is deemed expedient to inquire into. Our understanding and impression is, however, that this standard has been in no way lowered, so that the comparative numbers are truly indicative of the proportion of serious train accidents.

In connection with the current epidemic of Exposition accidents, a correspondent makes us the following suggestion:

> Referring to the recent rear collisions on Western railroads, it would be well to call editorial attention to the position of markers or tail lights. I noticed while at Chicago, recently, that many of the Western cars have these signals low down. This used to be the Pennsylvania R. R. practice until a disastrous collision in October, 1880, which cost that road about $500,000, I have heard. Since then the P. R. R. has carried its signals at the level of the roof, as shown by sketch.

The suggestion is doubtless a good one, as giving a certain fraction of additional security at least at no sensible cost; but no very important gain can result from any such small change as this; nor can any amount of labor over rules do any great further good. The trouble is not with the rules; it is with the beings who have to conform to and carry out the rules by changing themselves into unforgetting machines, and who cannot do so, struggle as they will.

The exhibit of war material at Chicago has called forth from "The Engineer" an editorial on United States warships and their armament which must be pleasing to this country, notwithstanding the criticism of our contemporary on what it terms some sins of omission in our designs. "The Engineer," in passing in review the struggle for naval supremacy in the first quarter of a century following 1865, hardly gives this country its just due in bringing about the downfall of the old wooden navy and old ordnance, and in inaugurating the era of ironclad battleships that has cost the powers of Europe so much treasure in the decades immediately succeeding our Civil War. But, as our contemporary says, we did stop warship building on the cessation of hostilities and wisely left European nations to carry on the battle between guns and armor and to pay for their experiences. The United States, with an enormous war debt on its hands, had other uses for its money; and the wisdom of the course followed was quite as much the result of necessity as of choice.

But the awakening came at last, when, as compared with the fleets of the world, the navy of the United States was almost entirely made up of rotting hulls of antique design and ordnance that was exceeded in power by that of many of the more insignificant nations of the globe. Then, says "The Engineer," the United States constructors "In one tremendous stride passed, with hardly an intermediate step, from the small coast defense 'Manhattan,' with her 2,100 tons displacement and 19-ton smooth-bore guns, to the modern ship with the powerful quick-fire armament and steel armor." Our contemporary then contrasts the English "Blake," of 1889, with the U. S. S. "New York," of 1891, to the alvantage of the latter in armor, speed and in aggregate battery. But the criticism is made that in our ship the 4-in. steel belt armor ends too abruptly, without longitudinal or cross defense; that the English ship carries more ammunition and protects it thoroughly all the way from the magazine to the gun, and that in coal capacity the "Blake" can steam 15,000 miles, at a 10-knot rate, as against 13,500 miles for the "New York." But leaving these points to the designers, our contemporary goes on to say that while the Americans at first adopted the best European patterns and methods in making armor and guns, they made such radical and rapid progress that it seriously questions "if Schneider could successfully compete with Bethlehem at the present moment." "The Engineer" awards the palm for successfully resisting the attack of powerful guns to the Bethlehem-Harveyed steel plate, now on exhibition at Chicago. While Schneider introduced nickel into steel, our contemporary again says that this process has been so well carried out in the United States "that at the present time it may be questioned if their examples of successful nickel-steel plates do not fully rival those of Europe. The most advanced and powerful plant for the manufacture of steel forgings and armor, including the heaviest hammer existing, is to be found at Bethlehem." The United States is also credited by our contemporary with a more perfect system of examining and testing armor than elsewhere exists. While the people of the United States have every reason to be proud of the character of the "new navy" and of the great advances made by our naval designers and native makers of war material, it is pleasing to have these views confirmed by so well posted a foreign authority as "The Engineer."

Another attempt is to be made at the next regular session of Congress to revise the laws governing the inspection of steam vessels and their machinery. As most engineers know, the laws and rules controlling the government inspection of steamboat boilers are ridiculously antiquated and inefficient. Their faults are not merely technical, but are defects that constitute a menace to the safety of the passengers and crews of all steam vessels under United States registry. The absurd form of boiler plate test piece (a strip with a semi-circle punched out on each side) which was long ago discarded elsewhere because it gave tensile strength too high by as much as 20%, is only a sample of the crudities and glaring errors in the government rules. It is proposed to push again the Frye bill for the revision of these rules which failed of passage in a preceding congress. This bill was drafted, we believe, by a board of experts which included some of the ablest engineers in the navy. It was opposed, of course, by the class of people who wish to select their own factors of safety—and pretty low ones—for the boilers which they put in their vessels, and also on account of its requirement of a higher standard of attainments for engineers, in the examination for a certificate of competency. Probably this opposition will again be encountered this year; and with the well known apathy of Congress toward any measures in which "politics" is not concerned, the chances of success seem rather dubious. That this bill or some bill to effect the same object ought to be passed, however, probably no engineer acquainted with the facts will

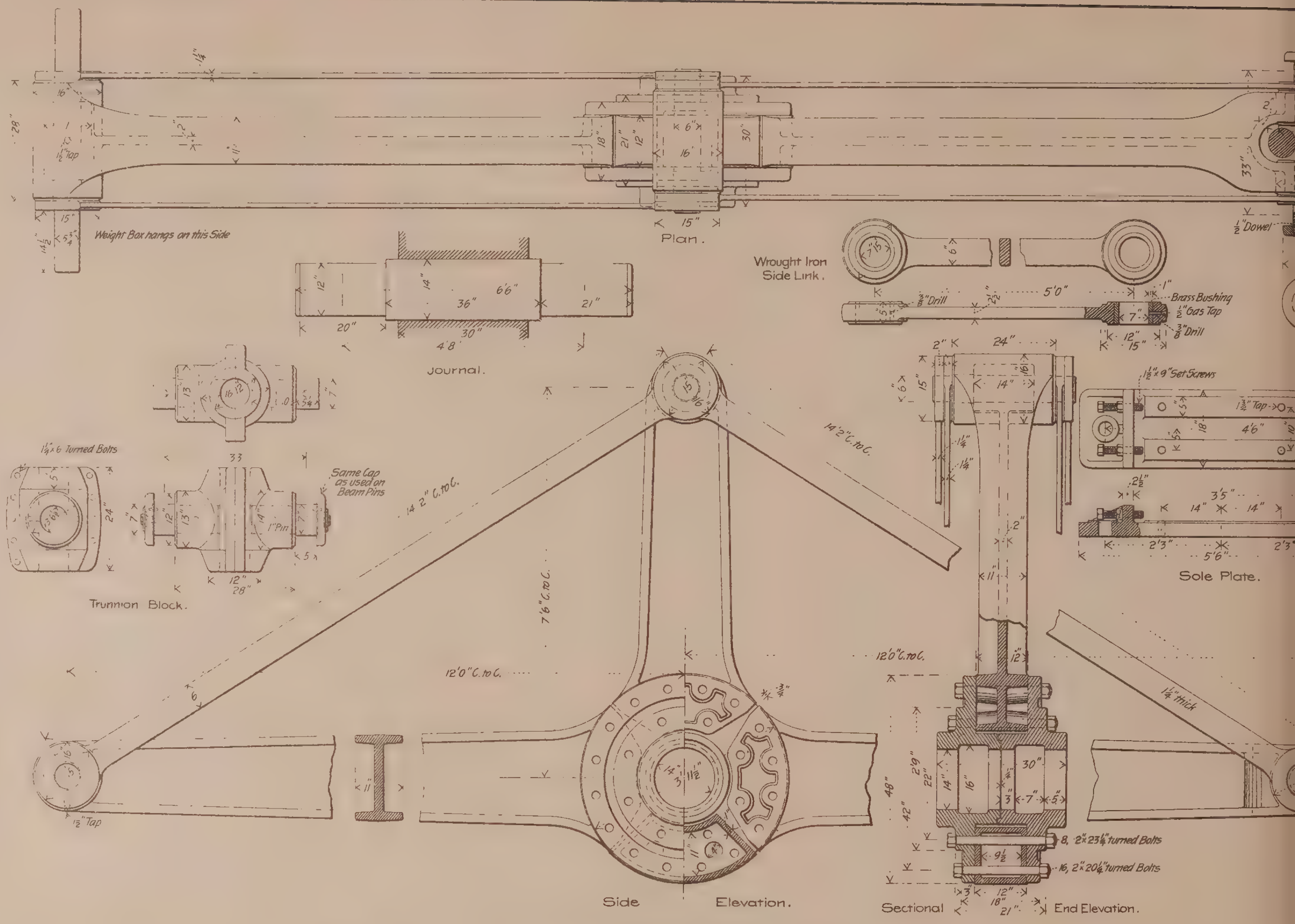


FIG. 10. DETAILS OF BALANCE BOB.

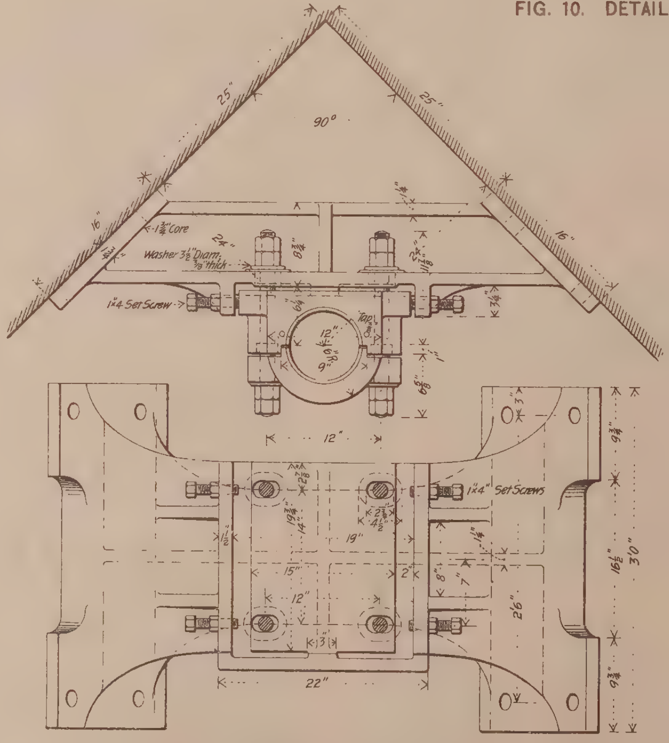


FIG. 3. GUIDES FOR PUMP ROD.

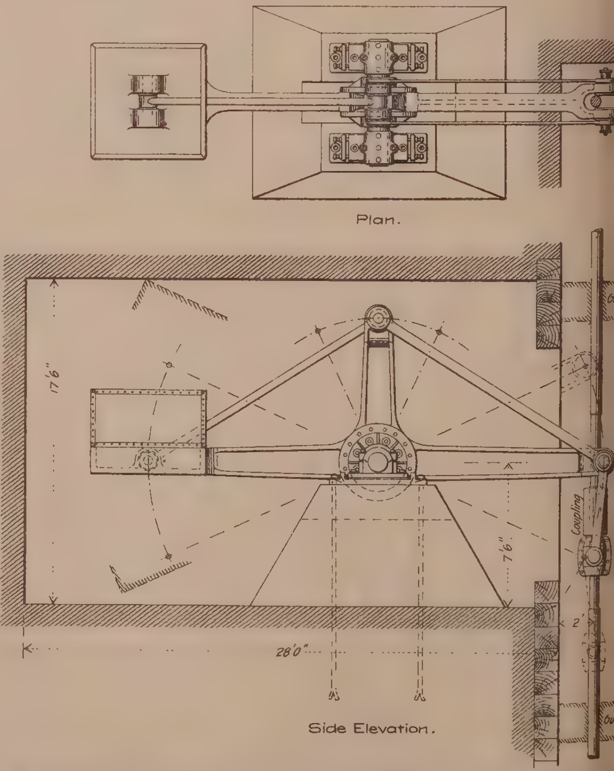
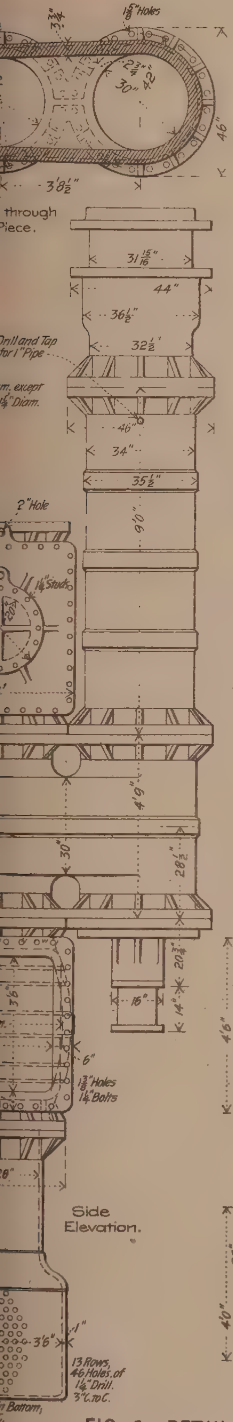


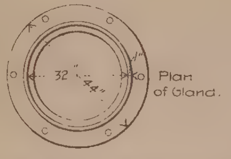
FIG. 9. BALANCE BOB CONNECTED TO PUMP ROD AT 550FT. LEV

SINGLE-ACTING MINE DRAINAGE PUMPS FOR

Designed and Built for the Chapin Mining Co., by the Ed



Side Elevation.



Plan of Gland.

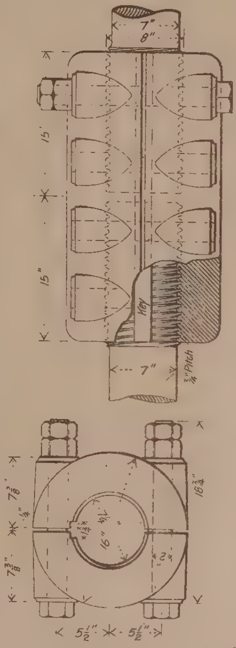
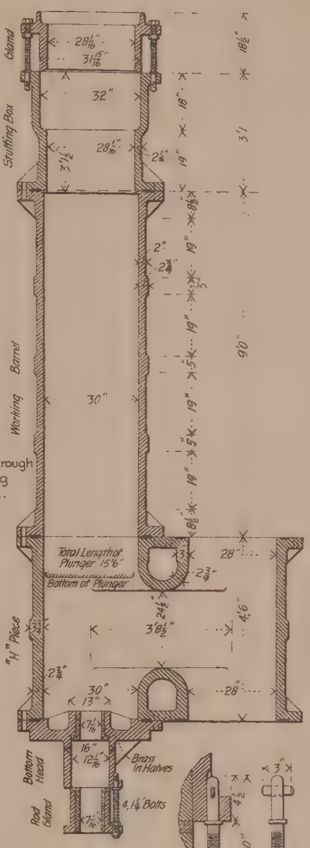
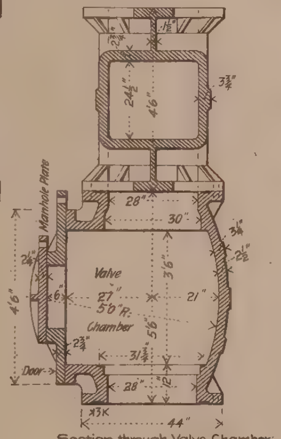


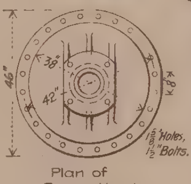
FIG. 5.
PUMP ROD COUPLING.



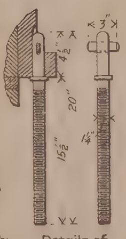
Section through Working Barrel.



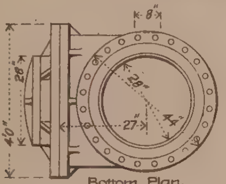
Section through Valve Chamber.



Plan of Bottom Head.

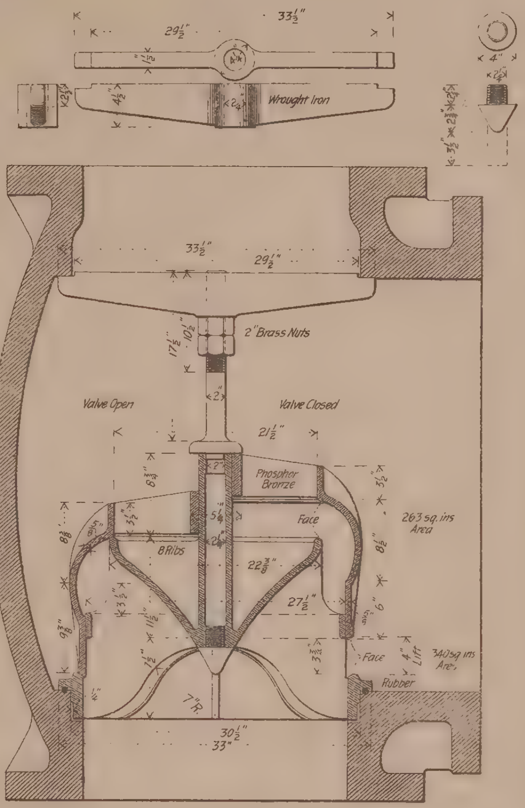


Details of Gland Bolts.

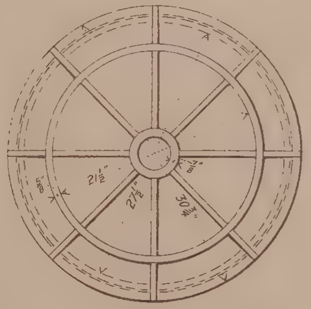


Bottom Plan.

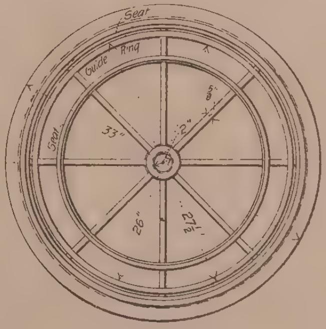
FIG. 6. DETAILS OF "CORNISH" SINGLE-ACTING PUMP.



Vertical Section.

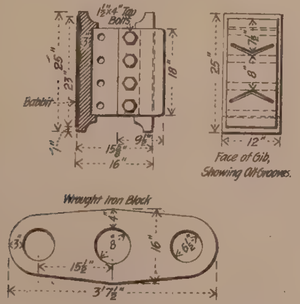


Top Plan of Valve.



Top Plan of Seat.

FIG. 7. DETAILS OF DOUBLE BEAT PUMP VALVES.



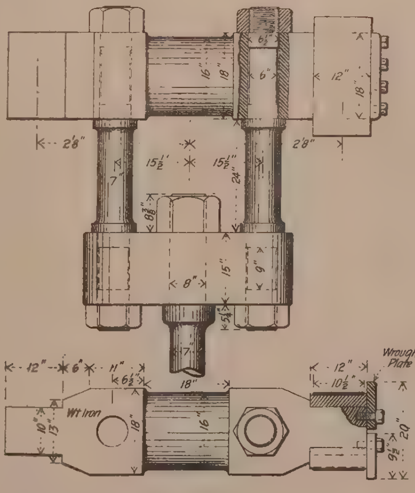


FIG. 4. DETAILS OF PUMP CROSS-HEAD.

T, CHAPIN MINE, IRON MOUNTAIN, MICH.

, Milwaukee, Wis., Edwin Reynolds, Superintendent.

CHAS. HART & SONS, LITH., 85 VESEY ST., N. Y.

dispute; but it may take some terrible disaster costing hundreds of lives to so arouse the press and the force of public opinion as to induce Congress to take action.

THE BEST METHOD OF DRAINING DEEP MINES.

We show on our inset sheet this week, and describe in another column, a great mine pumping engine, built by the Edward P. Allis Co., of Milwaukee, to drain the Chapin mine, at Iron Mountain, Mich. We illustrate this as the latest and probably one of the best and most scientifically designed examples of the old-fashioned type of pumping engine, a machine which, within the memory of men now living, was the most important and well nigh the only example of the useful application of the power of steam.

Of course, there is a vast difference between the pumping engines of James Watt's day, and the machine whose working details are shown on our inset sheet; and yet the typical features remain. The old Watt, Cornish and Bull pumping engines were located on the surface because they were much too large to be placed underground. The same is true of this engine. In the old Watt engine power was transmitted through a walking-beam; and designers have clung for years to the walking-beam as if it were an essential part of the engine's mechanism. The single-acting pump was another feature of the early pumping engines which we find copied in this machine, not, however, for the reasons which influenced the early builders of pumping engines, but for the great convenience and accessibility of the outside packed plungers. Its adoption, however, limits the machine to a very low rate of speed. The whole column of water in the standpipe rising from each pump has to be started from rest and brought to rest again at the beginning and end of each stroke. No air chambers are shown in connection with the pump, and it is apparent enough why anything approaching high speed is an impossibility. Even 10 strokes per minute, which is given as the limit of speed, must put a pretty severe strain on the pipes.

In our description of the pump on another page, we have briefly referred to the relative merits of the plan of locating mine pumps underground and placing them on the surface. We will not discuss that question here, for the simple reason that for such a problem as is presented at the Chapin mine either form of steam pump is out of date, and its adoption is bad engineering, for the work could be done far more cheaply and perfectly from every point of view by electricity.

We deem it worth while to explain this in considerable detail, for it is a good example of one of the most prominent faults of the average engineer at the present time, viz.: The neglect to keep informed and to take advantage of every new invention and improvement. Engineers as a class, especially the older members of the profession, are apt to pride themselves on their conservatism; and proper conservatism is, indeed, a virtue. But the conservatism which solves every new problem in just the same way the old ones were solved and which neglects to take advantage of every new invention and every improvement in science and art which is of real value—such a conservatism is no credit to its possessor and is an expensive luxury to those who employ him.

It is just as much an engineer's duty to keep himself informed as to the progress which is being made in any and every line which may have a bearing on his work as it is to know how to proportion his structures for the strains they must endure. The man who employs an engineer to build a railway or to design a bridge or a locomotive or a mine drainage plant, if you will, is entitled to have the best results at the least expense which the state of the art warrants. If the engineer in building the railway neglects to take into consideration the revolution in the cost of excavation which has been effected by the steam shovel, and so chooses a worse location for his line than might have been taken, he is by so much an unprofitable servant. Mistakes of this class we refer to, however, are more common in mechanical than in civil engineering; for the multitude of new inventions and improvements is so great, and their reflex influence on each other is so broad that even the most enterprising men despair of keeping pace with progress in any save a few limited specialties.

Returning to the problem presented at the Chapin mine, we have stated broadly that an electric pumping plant was far preferable to that which has been installed there. Let us see why. It appears that with the present plant, while steam can be used in the engine, it is proposed to use when desired, compressed air, piped from the company's water power air compressing plant, at Quinnesec Falls. When the plant is run in this way we have the following chain of power transmission: (A), Water wheels; (B), air compressors; (C), pipe carrying compressed air to the mouth of the shaft; (D), engine transforming energy stored in the air back to mechanical power; (E), walking-beam and pump rods; (F), pumps. With electric pumping on the other hand, we have: (A), Water wheels; (B), dynamos; (C), wire carrying current to the mine and down the shaft; (D), motors transforming current to mechanical energy and connected directly to (E), pumps.

The capacity of the present pumping plant is given as 3,200 gallons per minute when the plant is working at its highest speed, 10 revolutions; but if we rightly understand the case, this quantity of water is not now met with; the plant is designed to handle this quantity of water when the shaft reaches a depth of 1,500 ft., and taps veins of water lower down in the rocks. When the shaft reaches this depth and 3,200 gallons of water per minute is pumped, the total work done in horse power will be $\frac{3{,}200 \times 8.32 \times 1{,}500}{33{,}000}$, or in round numbers, 1,200 HP. At present, however, the total lift is only 600 ft., and if we assume that four strokes per minute is sufficient to take care of the drainage, we have at present only 192 HP. as the amount of work actually done in lifting water. Of course the loss of power in friction of pump rods, balance bobs, walking-beams, flywheel and in the friction and shock in the water itself, which has to stop and start again at every stroke, must be enormous; and the total power generated by the engine to do 192 HP. of work in raising water would probably not fall short of 500 HP. In addition it is to be remembered that economical steam consumption at only four revolutions per minute is out of the question.

Suppose, however, that the plant is run by compressed air. Call the loss in transmission of the air from friction and leakage 15%, then the air compressors at Quinnesec Falls must deliver air sufficient to develop $500 \div 0.85 = 588$ HP. The compressors themselves will be doing very fairly if they work with 85% efficiency, hence dividing again by 0.85 we have 692 HP. as the energy which must be delivered by the turbines at the falls to do 192 HP. of work in pumping at the mine.

With an electric plant, on the other hand, there should be not over 35% loss in friction of the moving water and of the mechanism between the pump and the motor; the motor itself ought to work with at least 90% efficiency, and we may allow a loss of 10% on the line and 10% in the dynamo. Then the work to be delivered by the water wheel will be: $192 \div (0.65 \times 0.90 \times 0.90 \times 0.90) = 405$ HP. Thus, making assumptions entirely reasonable, it appears that the electric system would save about 300 HP. compared with the present system.

The economy of power, however, is among the least of the advantages which the electric system can fairly claim. The great contrast between the two systems is in the first cost of the plant required. As stated above, when the shaft reaches its full depth of 1,500 ft. and the pumps work at 10 strokes per minute, the work done will be about 1,200 HP. Allowing 50% loss by friction in pumps, pump rods, and engine, the engine will have to indicate 2,400 HP.; 85% efficiency in the compressed air transmission and in the air compressors will give 3,320 HP. to be generated by the water wheels.

It is not likely, however, that water power is available for anything like this demand. Compressed air will probably be used in the engine only when there is surplus power available at the falls which is not required to work drills and other mining machinery driven by compressed air. Perhaps the designers do not even contemplate the use of air in the engine when the mine is in operation, and have only made provision for it so that they can keep the mine pumped out when it is lying idle without expense for fuel. In comparing the two systems, therefore, we will charge to the steam system only the plant at the mine, consisting of the engine, weighing 600 tons, pump rods weighing probably 125 tons, the pump rod guides, pumps and balance bobs shown on our drawings, and the water pipe in the shaft, 28 ins. in diameter.

Turning now, to the electrical plant, it is evident in the first place that there is no need here to provide capacity greatly in excess of present needs. More pumps, more dynamos or more water wheels can be bought in the open market and put in place on a few days' notice at any time. The plant required for present needs, then, is two 200-HP. water wheels at the falls, with a supplementary steam plant for use in times of low water or heavy demands on the water power for other purposes. This supplementary steam plant can be located at the falls if fuel is easily accessible there, or it may be placed at any other more convenient point where the saving in freight on fuel is enough to pay for the cost of duplicating dynamos and line wire. The cost of the line wire is, of course, very small compared with that of the pipe used to convey the compressed air in the steam system.

At the mine the conducting wires are led down the shaft to the pumps, and the system of dividing the total lift into sections of 300 ft. or so may well be adhered to, as we will thus avoid the use of heavy pressures in the discharge pipe. But the discharge pipe itself can be made much smaller than the 28-in. pipe used with the steam plant, for the water flows steadily upward in it instead of stopping and starting at every stroke, as it does with the single-acting pumps used in the steam plant. If we assume a velocity of 6 ft. per second in the discharge pipe, and a loss of head from friction of 5 ft. in each 300 ft. lift. then we will require a pipe only about 14 ins. in diameter to carry the maximum flow of 3,200 gallons per minute. But as this pipe is the only thing to be placed in the shaft—the pump rods, pump rod guides, etc., being done away with—we no longer require a special shaft for the pumping machinery. The 14-in. discharge pipe may be put in the corner of the hoisting shaft, or to still further economize room we may substitute for it two 10-in. pipes. Further advantages of this plan are that one line of pipe is available for use while the other is undergoing extension or repairs; or to save expense the second line need not be put in until the need for it actually arises, which, under the conditions assumed, will not be for some years to come.

Next, let us see what pumping power will be required for each 300-ft. lift. When pumping the full quantity of 3,200 gallons per minute, the work done in raising the wafer 300 ft. will be 240 HP. If the present flow to be taken care of, as assumed above, is only 1,280 gallons per minute, the work done will be only 96 HP. With fairly designed pumps the efficiency should be at least 75%, so the pumping capacity for present needs at each 300-ft. level will be 128 HP., or eventually 320 HP. A convenient way to carry this load will be by motors of 80 HP., of which we shall require at present two at the 300-ft. level and two at the bottom of the shaft, and eventually four at each level, or 20 in all. We can place these pumps in much smaller chambers than that which the steam plant requires for its balance bobs. All these pumps and motors may be duplicates of each other, so repairs and replacements will be greatly simplified. The failure of any one motor or pump is a matter of little consequence, as the others can be so made as to safely take an overload while repairs are being made. To regulate each set of pumps to work at just the rate of those below, so that the tank at each level shall neither overflow nor fall so low that the pumps will suck air, is a simple matter, and can be effected automatically, a float in the tank controlling the motor regulating apparatus.

The contrast between the size and weight of the machinery in the two systems is so great that even comparative estimates could hardly show more clearly the fact that the whole cost of the electrical plant is a mere bagatelle compared with the cost of the steam plant.

But the old school man may object that the electrical plant is an experiment, while the steam plant has the experience of nearly a century behind it and its adoption is dictated by a long line of precedents. The defect in this argument is that the electrical plant is not now an experiment in any sense of the word. There is not a machine in the plant whose design we have outlined which has not been tested in daily use under as trying conditions as would be encountered here. Most of the machinery can be purchased in the open market, and that which would be made to order is as well understood by its designers as the locomotive or the water wheel.

Moreover, let us analyze the reasons for objecting to experimental machinery. They are, first, that its first cost and cost of operation are uncertain, and second, that it is not known whether it can be relied on; neither of these reasons applies here. The cost of electrical machinery can be calculated in advance as closely as the cost of steam machinery, and its efficiency can be determined upon and measured with even greater ease and accuracy. As for reliability, the electrical system has the great advantage that it does not stake everything on a single ponderous machine. Any part of the system may break down without interrupting the operation of the system. Even without taking this into consideration it is a fact that an electrical plant of modern design is as reliable and as little liable to interruptions and breakdowns as a steam plant.

There is, however, one reasonable excuse for the adoption of the steam plant at this mine. At the time that the general type of the plant was decided on, nearly four years ago, we believe, electrical apparatus, and especially apparatus for the electrical transmission of power, was in a comparatively imperfect and experimental stage. It might have been urged with reason at that time that the reliability of an electrical plant was too uncertain to warrant its adoption in so important a place, and doubtless this was what settled the rejection of the electrical plant, if it was given consideration at all.* It is fair to say, moreover, that it is improbable that any blame should attach to Messrs. E. P. Allis & Co., the builders of the engine, for the adoption of a less efficient and more costly system than might have been used. They were merely the contractors for the machinery, the general design of which was probably determined upon by the officers of the Chapin Mining Co.

So much for the relative merits of steam and electricity at the Chapin mine. The reader who has followed carefully the foregoing discussion must perceive that the lesson to be derived is not confined to this single case. The merits of electrical pumping machinery are most marked, indeed, when compared with such a ponderous and costly engine and pumps as that at the Chapin mine; but it can also compare favorably with the cheaper and more compact direct-acting pumps which are most commonly used in mine drainage nowadays.

With an electrical plant, the cost, nuisance and waste of fuel due to a steam pipe running down the shaft are obviated, and in very many cases water power can be obtained for running the dynamos, thus saving the expense of coal. It is even possible in many instances, where the mouth of a drainage shaft is located at a considerable altitude, to use the very water that is pumped from the mine to operate the dynamos, leading it from the shaft mouth through pipes to the lowest available point in the vicinity and using it there to drive impact wheels connected directly to dynamos.

The application of electricity to the lighting of mines and the operation of mine locomotives has already made great progress. It is worth while pointing out that electricity is doubtless destined to be applied not only to the lifting of water from deep mine shafts, but to mine hoisting as well. In a deep mine shaft, as is well known, the weight of the hoisting cable is often in excess of the weight of the load to be raised. There is a limit to the depth which can be reached by rope hoisting alone. But with electric transmission of power there is no longer a limit to the depths of mine shafts. The rope may be entirely done away with and the motor may be mounted on the car itself; or, the lift may be divided into stages, each operated by electrical hoisting machinery.

We are not among those who join in the popular craze for praising all things electrical and hailing the electric motor as the successful rival of the steam engine. Electricity has been urged for adoption in certain directions where its success is at best problematical; and it has been unduly and extravagantly praised. At the same time the fact remains that we have in electricity a far more perfect and economical method for the transmission and conversion of power than has ever before been available; and whoever fails to take it into consideration in the solution of engineering problems where power transmission is concerned is likely to make some serious and expensive errors.

LETTERS TO THE EDITOR.

TRANSITION CURVES.

Sir: I notice the inquiry of "A Reader" in your issue of Oct. 5 regarding transition curve tables; and since you deplore the absence of any "satisfactory system," I have cut out a leaf from my notebook which you may publish if you wish. It is a table which I made and used before Mr. Searles' excellent book was published and is a curve of the same nature.

I do not see the necessity of such a variety as he has. I think my table is all that is necessary for a road with maximum curvature of 4°. For greater curvatures I would make another table for a curve increasing 2° per 100 ft. Three such tables ought to meet all requirements of railway alinement. Transition curves are most useful on easy curvature where speed is high. I think that spirals are usually made too short. Spirals can be located with the same facility as circular curves. The extra trouble comes in plotting. But transition curves are worth much more than they cost.

Yours truly,
A. M. Haynes.

Mankato, Minn., Nov. 9, 1893.

(The following is the table inclosed by our correspondent.—Ed.)

Spiral of 50-ft. Chords increasing in curvature 30 minutes per 50 ft.

Distant from B.C.	00	50	100	150	200	250	300	350	400	450	500	550	600
Curvature........		30′	1°	1½°	2°	2½°	3°	3½°	4°	4½°	5°	5½°	6°
Whole angle......		15′	45′	1°30′	2°30′	3°45′	5°15′	7°00′	9°	11°15′	13°45′	16°30′	19°30′
DEFLECTIONS from tan. at each 50 ft. point to each 50 ft. point on curve. A line given to each position of transit ⊙.	⊙	7½′	18¾′	35′	56¼′	1°22½′	1°53¾′	2°30′	3°11¼′	3°57½′	4°48¾′	5°45′	6°46′
	7½′	⊙	15′	33¾′	57½′	1°26¼′	2°0′	2°38¾′	3°22½′	4°11¼′	5°5′	6°03¾′	7°07½′
	26¼	15′	⊙	22½′	48¾′	1°20¼′	1°56¼′	2°37½′	3°23¾′	4°15′	5°11¼′	6°12½′	7°18½′
	65′	41¼′	22½′	⊙	30	1°3¾′	1°42½′	2°26¼′	3°15′	4°8½′	5°7½′	6°11¼′	7°20′
	1°33¾	1°17¼′	56¼′	30′	⊙	37½′	1°18¾′	2°5′	2°56¼′	3°52½′	4°53¾′	6°0′	7°11¼′
	2°22½′	2°3¾′	1°40′	1°11¼′	37½′	⊙	45′	1°34¼′	2°27½′	3°26¼′	4°30′	5°38¾′	6°52½′
	3°21¼	3°0′	2°33¼′	2°2½′	1°26¼′	45′	⊙	52½′	1°43¾′	2°50′	3°56¼′	5°7½′	6°23¾′
	4°30′	4°6¼′	3°37½′	3°3¾′	2°25′	1°40¾′	52½′	⊙	1′	2°3¾′	3°12½′	4°26¼′	5°45′
	5°48¾	5°22½′	4°51½′	4°15′	3°33¾′	2°47½′	1°56¼′	1°	⊙	1°7½′	2°18¾′	3°35′	4°56¼′
	7°17½	6°48¾′	6°15′	5°36¼′	4°52½′	4°3¾′	3°10′	2°11¼′	1°7½′	⊙	1°15′	2°33¾′	3°57½′
	8°56¼	8°25′	7°48¾′	7°7½′	6°21¼′	5°30′	4°33¾′	3°32½′	2°26¼′	1°15′	⊙	1°22½′	2°48¾′
	10°45′	10°11¼′	9°32½′	8°48¾′	8°0′	7°6¼′	6°7½′	5°5¾′	3°55′	2°41¼′	1°22½′	⊙	1°30′
	12°44	12°7½′	11°26½′	10°40′	9°48¾′	8°52½′	7°51¼′	6°45′	5°33¾′	4°17½′	2°56¼′	1°30′	⊙
Ordinate x.		.11	.55	1.53	3.27	6.00	9.92	15.26	22.21	31.00	41.82	54.87	70.32
Ordinate y........		50.00	100.00	149.99	199.96	249.89	299.74	349.45	398.97	448.19	497.00	545.27	593.8
L'g chord $\left(\frac{x}{\sin. d}\right)$		50.0	100.0	150.0	200.0	249.9	299.9	349.8	399.8	449.8	498.7		

Sir: "A Reader of Engineering News" makes some inquiries in your issue of Oct. 5 concerning transition curves. If he will communicate with me I will give him a method practiced by myself under years of railroad practice.

Yours truly,
C. A. Sundstrom, C. E.

Manayunk, Pa., Oct. 12, 1893.

CREDIT FOR LOCOMOTIVE DESIGNS.

Sir: In the "Personals" of your issue of Sept. 28 you state that I designed the engines of the Chicago, St. Paul & Kansas City Ry. As I do not wish to claim any credit which does not belong to me, I wish to state that the engines of that railway were built from specifications furnished by the railway company prior to my connection with it. My time, however, during my connection with the mechanical department of that company, was mainly spent in preparing drawings for the reconstruction of some of the above engines to conform with the ideas of Mr. W. T. Reed, the present superintendent of motive power.

Yours truly, B. J. Arnold.

Chicago, Oct. 4, 1893.

INSTRUCTION IN SURVEYING AT COLUMBIA COLLEGE.

Sir: I am much obliged to my friend, Mr. Greenleaf, for calling my attention to an imperfect and incorrect newspaper report of my remarks on the subject of surveying, made before the educational section of the Engineering Congress in Chicago. I did not express the sentiments which he criticises, nor do I hold such opinions at all. In a short time the discussion to which he refers will be published and it will then be seen that the remarks made by me were of a very different nature from what he supposes.

Mansfield Merriman.

Lehigh University, Oct. 7, 1893.

(As the member of our staff who prepared the report of the "Engineering Education" congress attended the sessions and reported the proceedings of three other divisions of the Engineering Congress at the same time, the inaccuracy in reporting Professor Merriman's remarks is not remarkable.—Ed.)

PROPORTIONING PITOT TUBES.

Sir: In answer to your correspondent L. Y. S. in your issue of Oct. 5: A few years ago, in cooperation with Mr. L. Francisco Verges, I had occasion to use a Pitot tube in some hydraulic experiments at the Massachusetts Institute of Technology. We wished to investigate the distribution of velocity in jets from standard orifices, and the instrument used was especially adapted for attachment to the tank in the hydraulic laboratory. But the shape of the tube itself was not essentially different from that which would be desirable to use in pipes or open channels.

The point was an iridium tip from a stylographic pen, and was 0.018 in. diameter outside, with an opening of 0.011 in. at the tip. We found the actual velocity indicated by the instrument for the center of the jet to be within 0.25% of the theoretical velocity due to the head.

A cut of this Pitot tube, together with two other forms of the same used by Mr. John R. Freeman, M. Am. Soc. C. E., in his experiments, is to be found in Engineering News, June 22, 1893, accompanying an abstract of a paper by Prof. Dwight Porter upon the "Hydraulic Laboratory of the Massachusetts Institute of Technology." A description of Mr. Freeman's instrument is to be found in his paper upon the "Hydraulics of Fire Streams," contained in Trans. Am. Soc. C. E., Vol. XXI., November, 1889. Upon p. 418 Mr. Freeman states that the coefficient of the instrument which he used was found to be unity, probably within 0.25% and certainly within 1%.

Truly yours, Morris Knowles.

13 Beacon St., Boston, Mass., Oct. 13, 1893.

Sir: I notice in your issue of Oct. 5 a query concerning the proportioning of Pitot tubes for measuring the flow of water.

Perhaps a few words concerning the application of this instrument to measuring the flow of gases will be of interest. My first application of the Pitot tube to gases was in 1873, to measure the flow of air. For the past seven years it has been found a most useful appliance in measuring the flow of natural gas from gas wells, in pipe line mains and in service pipes.

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*A letter from Mr. Jas. McNaughton, Superintendent of the Chapin Mining Co., to whom proofs of this article were submitted prior to its publication, states that at the time this pumping engine was contracted for, operating pumps by electricity had not been sufficiently tested to warrant its adoption.

I inclose a pamphlet gotten out to serve as a brief manual for use in applying the Pitot meter or gage to gas wells, gas and oil pipe lines, water in streams or pipes, etc. Various forms of tips and the construction of instruments and mode of applying in various cases are illustrated. I have found no considerable difference in results whether the tip was considerably tapered or was straight back from the end.

Very respectfully,
S. W. Robinson, M. Am. Soc. M. E.
Ohio State University, Columbus, O., Oct. 13, 1893.

(The pamphlet inclosed by Professor Robinson gives a very clear explanation of this interesting application of the Pitot tube, which will doubtless be new to many of our readers. It occurs to us that an excellent wind pressure gage might be designed on this principle. If any of our readers have experimented in this direction, we shall be glad to put their results obtained on record.—Ed.)

PRICES OF HIGH-DUTY PUMPING ENGINES.

Sir: In your issue of Oct. 12 appears an editorial referring to a comparison of the bids recently received for a 15,000,000-gallon pumping engine at Providence, R. I. While conceding that the triple-expansion pumping engine is being favorably considered by intending purchasers of high-duty, reliable pumping engines in the markets of the country, it is also equally true that the original first cost of these engines is much more than that of compound engines.

The conditions at Providence were rather peculiar. The space at the disposal of the engineer in the pumping station for this engine made it impossible for manufacturers of the rotative type of triple engines to submit propositions thereon, for the want of space in the building, consequently, with but two exceptions, the bids were all for compound vertical engines. Had the space at the disposal of the engineer in the pumping station at Providence been sufficient for the admission of the rotative type of triple engines, bids would have been submitted for a 15,000,000-gallon pumping engine with a guaranteed duty of 130,000,000 ft.-lbs., with 125 lbs. steam, at a cost not to exceed $80,000, exclusive of boilers.

But my main object in referring to your editorial is to call your attention to an error which appears therein. I will quote the paragraph and make the correction. You say:

> Another fact of interest in connection with these bids is the very low price at which this class of steam machinery can be purchased. The lowest bid for this plant was only about $55,000, and this for an engine on which 115,000,000 duty was guaranteed.

This is an error which you should in justice correct. The bid to which you refer is that of the Geo. F. Blake Mfg. Co., of Boston, Mass., who bid on a horizontal cross-compound engine, for $52.787, as given in Mr. Shedd's schedule, upon which engine they guaranteed 115,000,000 ft.-lbs. duty. The price asked for this engine, all things considered, is as great in proportion as that asked for any other of the engines offered. While the piston speed of the engines offered by the other bidders on both the vertical compound and vertical triple-expansion type, ranging from 140 ft. to 216 ft. per minute, the piston speed of the engine offered by the Blake Co. to pump 15,000,000 gallons per day would be 390 ft. per minute, and the piston speed of the engine selected by the city of Providence is only 140 ft. per minute. Thus you see that the bid of the Blake Co., though apparently low, is for a very small sized machine in comparison with the others, and one in which the horse power is developed at the expense of a high rate of piston speed, thereby very materially lessening the first cost of the engine. When it becomes practically demonstrated that a large column of water can be moved with a pumping engine, with safety, at a piston speed of 400 ft. per minute, I have no doubt that manufacturers engaged in the production of pumping engines will be able to put upon the market engines equally as cheap as those who are attempting the feat at present.

It must be further conceded by those interested in this discussion that the original first cost of the vertical type of engine is much greater than that of the horizontal type.

Yours respectfully, "L."
Chicago, Oct. 14, 1893.

"BOROUGH CORRECTION."

Sir: The writer, who is the borough surveyor of a Pennsylvania town of some 3,000 inhabitants, desires to mention a peculiarity in the measurements of his town which may be of interest to engineers.

Our "borough correction," as it is called, consists of a certain amount to be added to every measurement for property in the borough, at the rate of 1 ft. in every 500 ft. That is, if a man owns a lot of ground which, by his deed, should be 50 ft., he is really given 50 ft. plus 0.1 ft., equal to 50.1 ft. As nearly as I can ascertain the facts, this arose from the following cause: The original surveyor who laid out the town about 1850 had a chain which was too long by just enough to make 1 ft. in every 500 ft. Hence every square that he laid off and marked on the plan as 500 ft. really contained 501 ft. When the first regular borough surveyor came to be appointed (the gentleman who preceded the writer) he discovered the error that had been made, and instead of calling these different squares by their true distance of 501 ft. (which, however, would have caused trouble in the title of lots which had passed previous to that time), he continued to call the squares 500 ft., as marked on the plan, and, to equalize matters, gave to each owner a little more ground than his deed called for, just in the proportion of 1 ft. in every 500. This has been the custom ever since. It divides the extra foot in each square equally among the different owners, and is a just and equitable arrangement.

It is claimed for it, that, although an error in the first place, it has really resulted in good, as it has prevented many property line disputes by allowing a little leeway for encroaching one way or the other without depriving a neighbor of the full front his deed calls for.

It does, however, do this: Suppose I am to lay off a lot in the middle of a square described as so far from the side street. When I have measured from the side street and then added the correction corresponding to that distance (so as to give each intermediate owner his share of the extra foot), I have really shifted this man's lot five or six inches on land which, by the absolute measurement and description in the deed, belongs to his neighbor. On the other hand, if there were no correction added, then some one would get this extra foot without paying for it, which would be unfair. The extra foot cannot be assigned to any one particular lot, because the lots are described as sometimes measured from one side street and sometimes from another; and even if it were assigned to its proper place, a man might hesitate to buy it, because by the plan on record there are only 500 ft. in that square while he is buying still one more foot.

It amounts to this: I have either to shift a man's lot over on ground which his neighbor's deed calls for, or else lay out the lots exactly as the deeds call for and allow some one to get an extra foot without paying for it. It is evident that every man in the square gets all that his deed calls for—and a little more, too—but still he does not get the piece of ground he bought, and the question arises whether this "borough correction" business is just the way to dispose of the difficulty without at some time getting fast in a legal quagmire. I would like to ask whether other city surveyors have had experiences similar to this, and how the matter has been treated. C. M. B.

(The most noted instance of "surplus or deficiency" in land measurements with which we are conversant is the city of Chicago. The original sections of 160 acres, like most of such government surveys, were seldom exactly correct, according to the more accurate chaining of city surveyors. In the subdivision into city lots of varying dimensions, the most remarkable errors in measurement occurred and were perpetrated, and no lot survey in Chicago is considered complete which does not take into account the question of "surplus or deficiency" that may, and most likely does, occur. The matter is simply one of comparison of measuring instruments, whether chains, tapes, or rods, and the degree of accuracy maintained in keeping chains or tapes to the standard, and the expertness and faithfulness of the chainmen. What used to be considered good work in Chicago in early days would not be tolerated now. The rule is to take well authenticated original monuments and divide the intervening distance pro rata with the recorded measurements among the lots; the original monuments must stand, no matter what the incongruity may be, or what injustice may be done to adjoining lot owners. Where the original stake was planted and recorded, there must it stay. This whole question is a familiar one with Chicago surveyors and the veteran City Surveyor, S. S. Greeley, of that city, is probably the best authority in America on the subject.—Ed.)

THE CHESTER BRIDGE DISASTER.

Sir: It has been a matter of surprise to the writer that the discussion of the Chester Bridge disaster has generally assumed that the scheme of repairs was a good and commendable one but was badly executed. On this assumption it is not surprising that the Railroad Commission and the public are disposed to fix the blame on the unfortunate foreman Belville.

It is pertinent, therefore, to point out that the whole scheme of strengthening the bridge was poorly conceived both in theory and in the practical method of the work at its best. And this criticism is important because it applies not only to the wrecked bridge but to the other structures which are assumed to have been "strengthened" by a similar process.

1. The scheme of repairs was bad in theory because it increased the eccentricity of an already badly balanced compression member.

2. It was bad in practical method to add additional material to the chord without first relieving it from strain.

There is no doubt at all that a thorough-going bridge man who meant to do this bridge some real benefit would first have trestled it. And there is just as little doubt that any practical bridge engineer who followed good American practice would have planned to strengthen his chord in some other way than by another cover plate. We do not increase chord sections in American practice by adding cover plates (see Mr. Cooper's specifications on this matter of covers).

The only criticism which Professor Swain passes on the original design of this bridge is that the chord has no bottom angles. That means of course that the center of gravity (or of inertia) was out of the center line of stress; that is, it was eccentric.

The addition of another cover increased this eccentricity, and the presumption is so strong that it would do more harm than good, that the plan would be discarded in any committee of bridge engineers. The essential fact of the whole scheme of repairs of Chester Bridge is that it was perfunctory, and bears no evidence of serious intention to do the bridge a real benefit. Is it not a fact of observation that repairs suggested by State Commissioners are often executed by the railroads in just this way?

Frederick H. Lewis.
Philadelphia, Oct. 10, 1893.

(We entirely agree with our correspondent, and have perceived from the first that one of the methods he objected to, riveting "strengthening" plates not under strain to bridge members under exceptionally severe strain, was shockingly defective. The other detail, which, if true, is equally objectionable, that the chord strains were originally eccentric, and the addition of the "strengthening" plates further increased this eccentricity, we were not before aware of, as we were not able to procure drawings of the bridge for publication. Of course, the proper thing to have done, and the only thing a sane and cautious man who respected his own reputation and the lives of the public would have permitted to be done, was to trestle the bridge before attempting to repair it by reconstructing its chords and other members.

But the other features of the disaster were so much worse than any mere errors of method that we have felt it to be a kind of anti-climax to dwell upon these minor points, however otherwise discreditable, as constituting any sensible part of the burden of shame for that disaster. Moreover, we wished to call especial attention to the fact that the mismanagement and lack of management which caused this disaster was not confined to this one case, but has been common; so that at a dozen or score of New England bridges which have been repaired from time to time during the past few years a wreck has been possible at the crossing of every train while repairs were in progress.

Ignorance is not a crime, but that degree of persistent, continued and general recklessness which has been displayed by New England officials and contractors in respect to this class of bridges belongs distinctly in the category of crimes and cannot be excused as mere ignorance. It is transparently and evidently hazardous in the extreme. It is greatly to be regretted that the report of the Massachusetts Railroad Commission did not probe deeper into the facts and make them known, instead of making the mere white-washing half-report which they did. The only sound excuse for such a report is probably the real one, that the commission felt they were going beyond the limits of their experience and competency in thus probing into generalities, as a board of engineers would doubtless feel if compelled to investigate a medical or legal issue. When the public learns to put such expert work in the hands of experts and to keep it there, then they can expect it to be well done. Until then they never can. The English have learned his lesson, but Americans have not. —Ed.)

COMPARATIVE TESTS OF SINGLE ACTING AND DUPLEX AIR-BRAKE PUMPS.

Sir: In your issue of Sept. 14 there appeared a statement by the Westinghouse Air-Brake Co. of a comparative test of the Westinghouse Air-Brake Co.'s 9½-in. air pump and the New York Air-Brake Co.'s No. 2 duplex air pump. It is so at variance with actual results universally obtained with our duplex pump that we repeated the tests under the same conditions, measuring the air, with three reservoirs, in the same way. The results of the tests were as follows:

Pumps.	Time required to compress one "unit volume"* of air to a pressure of 90 lbs. per sq. in., seconds.	Steam used per unit volume of air compressed, pounds.	Total piston travel, ft. per min.
New York No. 2 Duplex (two 7-in. steam cylinders, and two air cylinders, 7 and 10 ins., respectively)	7.174	1.881	174
Westinghouse 9½-in. simple	9.799	2.744	108.3

The test proves the New York duplex pump delivers 34% more air per minute than the Westinghouse 9½-in. pump. It also shows that the New York duplex pump delivers 46% more air with the same amount of steam. This is in accordance with the results which should be expected from the principle of construction of the duplex pump. The capacity of the two air cylinders is 50% greater than the capacity of the two steam cylinders. Both air cylinders are filled with free air every stroke, and this is delivered to the reservoir. The efficiency must, therefore, be 50% greater than is possible with the Westinghouse pump, as that can only receive one measure of air for one measure of steam.

If any different results have been secured with the New York duplex pump it is because the pump was out of order.

The amount of heat developed in compressing air is in proportion to the rapidity of compression. A higher temperature might, therefore, be expected from a pump that compresses 34% more air in a given time. Our duplex pump was designed for a special purpose, namely, to furnish air for operating air-brakes. In this service it is utterly impossible to generate sufficient heat to impair the efficiency of the pump.

Yours truly, The New York Air-Brake Co.
New York City, Oct. 16, 1893.

(We have changed the headings of the table in the above letter and added the footnote to make the method of the test more clear, as we did in publishing the test made by the Westinghouse company, in our issue of Sept. 14. For clearer understanding of the methods of the test, reference may be made to the cut which appeared with the report in that issue, as the above letter states that the test was made under the same conditions and by the same method as the test formerly reported. —Ed.)

THE FRENCH ENGINEERS IN BOSTON.

Sir: The visit of the French engineers to Boston on Oct. 4 and 5 was an occasion of so much interest and the newspaper accounts have been so imperfect that I send you the following brief description of the way in which they were entertained during their brief stay in this neighborhood.

Fourteen members of the Society of Civil Engineers of France reached Boston early in the morning of Oct. 4. They were met by a committee representing the Boston Society of Civil Engineers, the executives of the city water and drainage departments, and the "Eighty-niners" of the American engineers. The committee consisted of Prof. W. Watson, Chairman, and Henry D. Woods, Secretary; John R. Freeman, President of the Boston Society of Civil Engineers, and H. H. Carter, S. E. Tinkham, E. W. Howe, Thomas Doane, James A. Tilden, C. J. H. Woodbury, James T. Boyd, Prof. G. Lanza, Frederic Brooks, Geo. S. Rice, Albert F. Noyes and others.

The guests were on their way to New York to take their departure for France, having visited the Exposition in Chicago. It was therefore necessary to arrange the program so as to fatigue these gentlemen as little as possible and yet give them a little idea of the public works and the beautiful suburbs of Boston.

At 9:45 a special electric car was taken for Franklin Park, where carriages awaited the party, for a drive through the park under the guidance of E. W. Howe, Assistant Engineer in Charge of Parks. The route next lay through the private grounds of Prof. C. S. Sargent and the most beautiful portions of Brookline to the Chestnut Hill Reservoir of the Boston waterworks. The general scheme of these works was briefly explained, after which another car was taken over the Beacon St. Boulevard, through Commonwealth Ave., to the Massachusetts Institute of Technology. Here a brief inspection was made of this renowned school.

The party was then driven to the Union Club, where lunch for 30 was served at 1:45. This repast was a very pleasant feature of the trip. After the yellow legs of the Massachusetts Coast had been properly seasoned with champagne from la belle France, toasts were pledged under the wreathing smoke of fragrant Havanas, and eternal friendship sworn again between France and America.

Remarks "appropriate to the occasion," and of course in classical French, were indulged in by the Chairman, Professor Watson, and Messrs. Freeman, Woods, Carter, Woodbury and others, and responded to in equally classical English by the distinguished guests. Everybody was happy and at 3 p. m. carriages were taken to the steam tug. Under the guidance of Mr. H. H. Carter a trip was taken down the harbor, where an examination was made of the sewerage system. The huge pumping engines were duly admired, and the substantial constructions on Moon Island, comprising the storage reservoirs and outfall sewer.

Seats at the theatres had been secured for the evening, but over this portion of the entertainment a veil may well be drawn.

On Thursday morning, Oct. 5, the party met at the station of the Boston & Maine Ry. and visited Lawrence by special train, which was placed at the disposal of the party for the day, through the courtesy of Mr. H. Bissell, Chief Engineer, and J. W. Sanborn, General Manager.

The rich autumn foliage was never more beautiful, and as the enthusiastic French engineers sped past the Middlesex Fells, the Wilmington marshes and the hills of Andover, many were their exclamations of delight at the rare beauty of the autumn colors of the New England landscape.

At Lawrence the first visit was made at the new cotton spinning mill of the Pacific. The large Corliss compound engine, the standard method of slow burning plank and timber mill construction, and the installation of automatic sprinklers were all studied with interest, after which a visit to the print works was made. Several of the party were industrial engineers connected with large establishments in France, and all were apparently profoundly impressed by the completeness of the organization of this, which is the largest textile mill in the world.

At the Lower Pacific Mills the installation of the large turbines and the main driving system, with its bold examples of quarter twist belts, were found very interesting.

Next at the Washington Mills Co.'s great woolen mills a hasty call was made, and the party conducted by the manager to the features most interesting to industrial engineers.

Carriages then took the party up for a look at the Lawrence dam and over the river to the beautifully situated clubhouse of the Lawrence Boat Club, which had been tendered for the use of the party. After lunch the party divided, one section going to view the filter beds for the intermittent filtration of the city water supply, recently installed under the designs of Mr. Hiram F. Mills; the other section, composed of a few specially interested in textile manufacture, visiting the Arlington mills. Early in the afternoon the party returned to their special train and quickly made the run to Boston.

Where everyone did his best to make the visit of the French engineers a success, it may be invidious to mention the services of any particular individual; but I think all will agree that Mr. Freeman managed the arrangements with his usual skill, and that Mr. Woods is entitled to a lion's share of praise for the thoughtfulness which added so much to the pleasure of the party. Very truly yours, D. Fitz Gerald.
Brookline, Oct. 16, 1893.

AN IMPROVED HANGING COMPASS.*

By Guy R. Johnson, Longdale, Va.

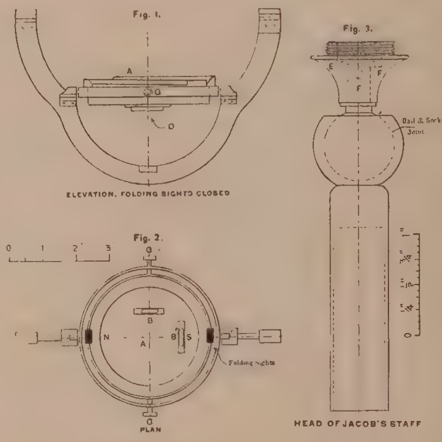
In working brown iron ore mines on the system employed at Longdale, namely, stoping from the top down, the usual procedure is to drive a succession of upraises from the lowest adit to the highest, or to the top of the deposit, as the case may be. These upraises are usually driven 120 ft. apart, along the strike of the vein. As the work goes on, they are connected by levels 10 ft. apart (vertically) and then serve as chutes.

A transit is useless in surveying these chutes, and the writer has for several years made use of a hanging compass. The method of using this instrument described in a former paper (Trans., XX., 105), embracing as it does the use of a cord and several strips of wood, is well enough in the chutes proper, where the total distance to be surveyed is comparatively small, but when extended to the levels between the chutes it becomes very slow and cumbrous. It was to obviate this objection that the instrument here described was devised.

My first idea was to carry another compass of the ordinary type, but the additional weight and inconvenience of carriage through the steep and narrow chutes caused this plan to be abandoned. After some correspondence with the instrument makers to ascertain the practicability of the change, the instrument herewith illustrated in Figs. 1, 2 and 3 was ordered.

In these figures A is the compass swung in gimbals, as in the usual form of the instrument; B and B' are two small levels, sunk into the bottom of the compass box, one on the N.-S. and the other on the E.-W. line. With these the instrument can be leveled perfectly. Outside levels would have interfered with the gimbals. The folding sights are of the usual pattern. In surveying in the chutes these are never raised, unless the line of sight is near the magnetic meridian.

D is a plate into which the cap E of the Jacob's staff screws. This departure from the usual form of Jacob's staff heads, in which the instrument turns on a spindle, the prolongation of the ball of the ball-and-socket joint, was occasioned by the necessity of having an easily portable instrument. The socket for the usual spindle would have made the carrying case much too bulky. The compass having been made fast to the head, revolves on the center F, the head E turning with the instrument.



Improved Hanging Compass for Mine Work.

In surveying the levels, the screws G and G' are loosened, and the compass is taken out of the gimbals. It is then used with the Jacob's staff, as in the ordinary form of the instrument. With the arrangement above described, which entails the carriage of only one extra piece (the Jacob's staff), the levels can be surveyed in about one-half the time formerly occupied, and the portability of the instrument is not affected. Also better speed can be made in the chutes, as the slight extra weight, especially that of the plate D, makes the compass a great deal steadier on the cord.

A GERMAN IRON AND BALLAST BRIDGE FLOOR.

The use of solid metal floor systems for bridges, almost exceptional although slowly gaining favor in this country in railway bridge work, is the generally accepted practice for both highway and railway bridge construction in many European countries. Many of the more interesting examples of this type of construction, both of foreign and American practice, have been illustrated and described in Engineering News from time to time (see particularly Eng. News, March 23, Nov. 16 and 23, Dec. 7 and 28, 1889, March 26, Sept. 8, Oct. 27, 1892, and April 13, 1893). In connection with these we show in the accompanying illustrations reproduced from the "Zeitschrift des Vereins Deutscher Ingenieure," a solid bridge floor of German construction which presents some novel features in its design.

The bridge for which this floor was designed was constructed to connect the two parts of the town of Bernburg, which are separated by the Saale River, and replaced a wooden arch built in 1800. Originally the river had been crossed at this point by a stone arch bridge, but this structure had been partly destroyed by a flood which carried away three of the arches. These were replaced by the wooden span shown in Fig. 1, which was built, as before stated, in 1800. As will be seen from the illustration this wooden span was 31.65 m. (103.5 ft.) long and consisted of two trussed arches of rude design, built of 12 ins × 12 ins. timbers and having 18 ins. × 23 ins. floor beams. Originally the bridge was built only wide enough for a single wagon and with but one narrow sidewalk. In 1810, however, the trusses were moved farther apart to allow of the passage of two wagons, and cast iron brackets to support sidewalks 3.9 ft. wide were suspended on the outside. About 97 M. ft. B. M. and several tons of iron were used in the structure. The illustration also shows the location of the remaining arch under piers of the old stone bridge, and a curious wooden span of shorter length.

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*The "unit volume" of air was one cubic foot, measured at a pressure of 85 lbs., and at whatever temperature resulted from its compression. One cubic foot of air measured under these conditions is equivalent to something less than 4 cu. ft. of air measured at atmospheric pressure and temperature.

*Presented at the Chicago meeting of the American Institute of Mining Engineers (Division C of the International Engineering Congress).

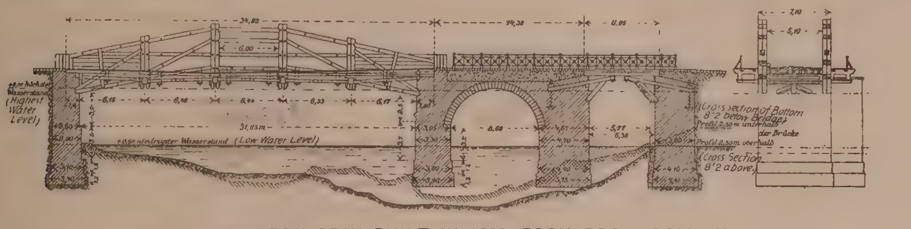
(Highest Water Level)
(Low Water Level)
(Cross Section of Bottom 8'2 below Bridge)
(Cross Section 8'2 above)

FIG. 1. WOODEN SPAN BUILT IN 1800, BERNBERG, GERMANY.

Owing to the large dead load of the bridge and the rapidly increasing traffic, which was considerably more than the design of the structure warranted, its center began to settle and the municipality of Bernberg decided to replace it by an iron bridge. As the increasing navigation of the river required a wider channel it was decided to remove the remaining stone arch and to construct an iron truss span of 149 ft., and a plate girder span of about 20 ft. To provide for the traffic during the erection of the new span a pontoon bridge was built and a sidewalk maintained on the falsework.

The main span of the new bridge consists, briefly, of two riveted trusses with curved top chords, placed 23 ft. apart c. to c., and 19 ft. high at the center. Each truss is divided into 14 panels of 10.65 ft. each. The top chord has an H-shaped cross-section varying in area from 41.8 sq. ins. to 48.7 sq. ins., and is composed of angles and plates. The bottom chord has a trough-shaped section, varying in area from 42.5 sq. ins. to 57.4 sq. ins. The diagonals are flat bars for the second and fourth panels from each end and of angles laced together for the others. The verticals are also composed of angles laced together. A somewhat novel form of upper lateral bracing is used. The four center panel points of the trusses are braced together transversely with latticed girders, and these are in turn stiffened by a longitudinal girder at the center line of the bridge. There are also complete systems of wind bracing for both the top and bottom chords. The short span is a plate girder of the ordinary design. The entire structure, excepting the intermediate floor beams, the curved troughs for the ballast and the plates near the bearings, which are soft steel, is of wrought iron. Including the removal and partial rebuilding of the pier and the construction of the temporary bridge the total cost of the structure was $31,900.

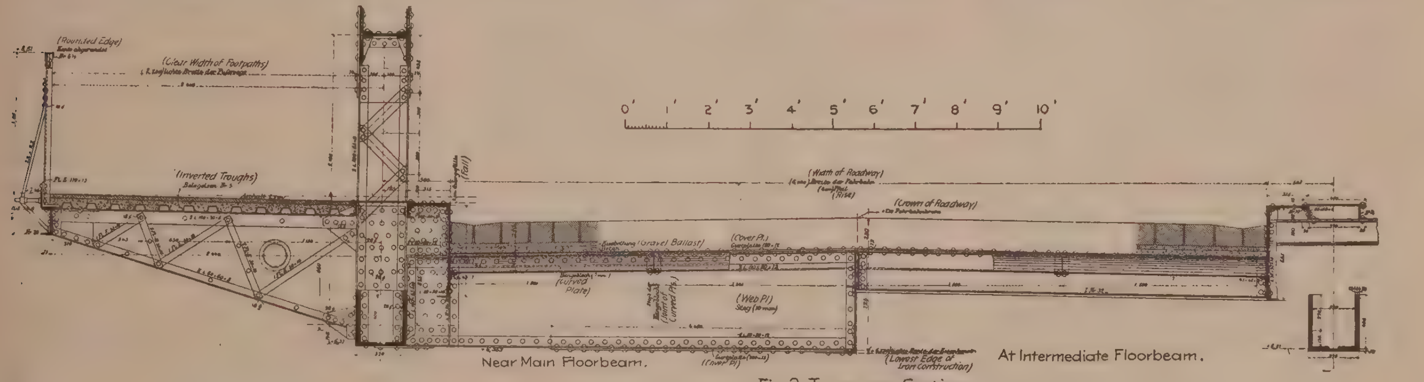

Fig. 2. Transverse Sections.

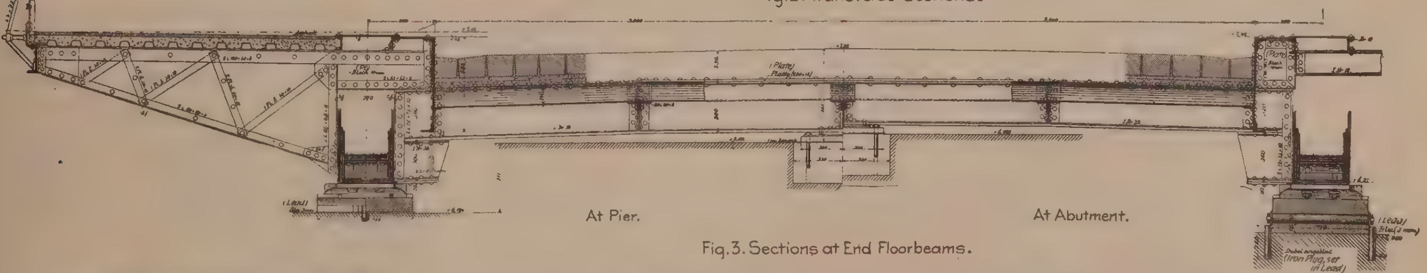

Fig. 3. Sections at End Floorbeams.

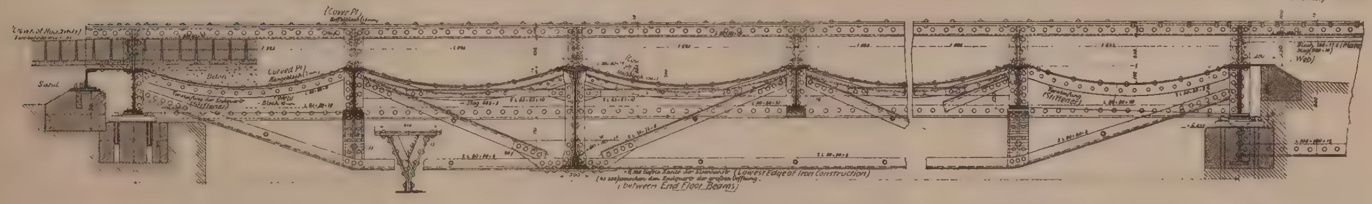

Fig. 4. Longitudinal Section through Center of Bridge

FIG. 2. DETAILS OF SOLID IRON AND BALLAST FLOOR, FOR HIGHWAY BRIDGE, BERNBERG, GERMANY.

The construction of the floor system, which is the principal point of interest, is clearly shown in Figs. 2, 3 and 4. The main floor beams are of I-beam section composed of webs and angles. Between these are placed intermediate floor beams of rolled I-beams, which subdivide the bridge into half-panel lengths. These intermediate beams transmit their loads to the main floor beams by means of three longitudinal stiffeners, the two outer of which consist of a web and angles and close off the ballasting of the roadway. The center stiffener consists of angles connected as shown in Fig. 3. The curved troughs for carrying the ballast are riveted to the top flanges of the floor beams and connected by angles to the side stiffeners, as shown in the illustrations.

As the bridge was constructed without camber the drainage of the roadbed and sidewalks was provided for by crowning the former and inclining the latter toward the side gutters of the roadway, from which the water was carried by openings in the side stiffeners. The ballasting consists of asphaltic concrete, nearly filling the troughs, covered by a layer of gravel 1 1-32 ins. thick in which are laid the granite paving blocks. This asphaltic concrete is composed of a mixture of coarse gravel, asphalt and creosote, and is stated to be impervious to water and very durable. The ironwork coming into contact with the ballast was painted with Goudron paint. The sidewalks are carried on brackets connected to the main floor beams by gusset plates, and are also supported at the intermediate floor beam points. They consist of iron troughs as shown in the illustrations carrying a ballast of "asphaltic concrete" covered by a 1-in. layer of asphalt.

PROTECTING PILES AGAINST THE TEREDO; L. & N. R. R.

The following interesting article on the protection of piles is an abstract of a paper to be presented at the meeting of the American Society of Civil Engineers on Nov. 1, and is reprinted from the society's bulletin. Some notes on creosoting as a protection from the teredo were given in our issue of Sept. 1, 1892:

In 1880 the Louisville & Nashville R. R. acquired control of what is now known as the New Orleans division of that road, and, with this, acquired also a large creosoting works, located at West Pascagoula River. This road crosses a number of bays, bayous and rivers, all of which are spanned by means of yellow pine creosoted pile trestles, and iron bridges supported by creosoted pile piers. There are 21,407 lin. ft. of trestle and 6,459 ft. of iron bridges. The most noteworthy structures, so far as the subject of this paper is concerned, are Bay St. Louis and Biloxi Bay trestles, the first of which is about two miles long, and consists almost entirely of creosoted yellow pine; that over the second is 6,040 ft. long and consists of 5,850 ft. of creosoted pile trestle. Each of these structures has an iron draw span 190 ft. long. These trestles were built in the years 1878 and 1879, and replaced structures which had been destroyed by the teredo, which in the waters of the Mexican Gulf and its estuaries is extraordinarily destructive on account of the long warm season. An untreated yellow pine pile, 12 or 15 ins. in diameter, would be rendered unsafe for structural purposes in less than six months.

In 1871 a serious accident occurred at the Biloxi Bay trestle from this cause, although the piles were only about ten months old; seven bents went down with a freight train, and it was found that the piles were all eaten off close to the bottom of the water. When first built, the trestle had hardly been completed when it was found that the untreated piles were so badly attacked by the teredo that rebuilding had to be commenced at once. In 1872 resort was had to covering the piles with copper, but the protection was not perfect. For this reason creosoting works were built in 1876, at a cost of $60,000. All creosoted structures have been periodically inspected, and the portion below water examined from time to time by divers. It was not, however, until 1886 that it was found the teredo had begun his attack on the creosoted piles. About the same time an inspection of the creosoted piles in the railway company's wharves, at Pensacola, Fla., disclosed a similar condition of affairs, and the question of determining, if possible, on some further means of protecting the creosoted piles against the teredo became a vital one.

As a result of investigation and experiment, it was decided to adopt a thin coat of cement mortar or concrete, applied to the outside of the piles from the surface of the mud or sand at the bottom to high water at the top. To accomplish this a shell of wrought iron made of circular form, composed of several sections, each in two segments, and so arranged as to be easily separated, was placed around the pile; the shell was clamped together above the water and lowered section by section until it completely surrounded the pile to a short distance below the bottom. A diver placed a puddling of "gumbo clay," inclosed in sacking, between the shell and the pile at the bottom, before the shell was forced down. Where the water was not more than 12 ft. deep, it was pumped out and the mortar or concrete poured in. Where there was more than 12 ft. of water this could not be done, and concrete was passed to the bottom of the shell, through a special galvanized iron pipe, with a funnel or feeder at the top for filling. This was raised as the space below was filled up. The bottom was kept constantly in the concrete. The shell was allowed to remain until the concrete had set, when it was removed and placed on the next pile. Shells made of wood with cast iron bands were also used, as being cheaper than the wrought iron. This method of treatment was applied to over 4,000 piles, but only such as had been seriously attacked, so as to prevent their total destruction. One important advantage of this method is that there is no disturbance of the piles or superstructure which rests upon them, a matter of special importance where the piles are under large storage sheds or other buildings.

There has been some little trouble experienced from logs or rafts striking the protected piles in rough weather, but the repairs have been small, and the protection, which has now stood seven years, bids fair to continue a number of years longer. Not only did the concrete completely cover the piles, and was itself covered with oysters, barnacles, etc., but the cement had found its way into the teredo holes, filling them even to the heart of the piles and forming within it perfect casts of the teredo. Not a single living teredo was found in the piles when afterward split.

The concrete used consisted of 1 of cement, 2 of sand, and 3 of gravel, with water enough to make it pass easily through the pipe. The cost of its use was found to vary from 80 cts. per lin. ft. measured on the pile, to $1.50 per lin. ft., depending upon the length of the protection, the location of the piles and the conditions of the weather; but as the number of feet protected was only from high water mark to the bottom, it was small compared with the total length of the piles, and much less than it would have cost to replace the old piles with new creosoted ones.

The next protection used was vitrified clay pipe. In 1892 a careful inspection was made of the piles of the Bay St. Louis and Biloxi Bay trestles; of these about one-half were found to be seriously affected, some were full of small holes, and a very considerable number had large holes. About 15% had been protected. It was decided at once to proceed with the protection, and also to strengthen the caps and stringers, which were too light for the existing rolling loads. The trestles had been in service 14 years, but were found, with the exception of a few ties, to be in a good state of preservation. It is expected that the life of the new cypress used will be as long as the remaining life of the old creosoted pine, and that, when renewal above the water is required ten or twelve years hence, a frame trestle can be placed on top of the protected piles.

Instead of using concrete protection for the piles, in this case vitrified clay pipe was used, first for economy, and, second, because it was believed to be a more certain protection at the immediate surface of the mud, it having been found that with the concrete protection, some of the mud had become mixed with the concrete at the bottom, killing the cohesive power and leaving the piles open for attack by the teredo. In most localities the teredo works near the surface of the water, between high and low tide, and his ravages become less as the bottom is approached. At Biloxi, this is different, due to the fresh water which flows in on top of the salt water, and the teredo thrives better near the bottom. It is quite common to find piles eaten off at the surface of the mud and showing no indication of attack above that point.

In order to allow the sections of pipe to be passed readily over the piles, they were cut off at some distance below the stringers, making it necessary to use a bolster or some other contrivance to support the stringers. The bolster was made to extend the full panel length, and its upper surface keyed to the lower surface of the stringers with cast iron keys, to make it act with the stringers. This also permits the easy removal of the sticks, or the bolster, independently of each other. There has been much trouble with both of these trestles on account of fires caused by sparks dropped from engines. It was, therefore, determined to box in the floor and cover it with gravel.

The sections of the pipe were fastened together with a composition of pitch and sand, applied hot. This was cooled as each joint was lowered below the surface of the water, and became hard so as to hold the sections firmly together. In this way section after section was added until a solid bearing below the mud surface was reached. Jacks were used to force the pipe down, after which the space between the pile and pipe was filled with sand, which was allowed to settle. After several months the pipes were again filled, to make up for settlement and that which had been washed out by waves, and they were then sealed on top with the hot pitch and sand. The cost of this protection was 66 cts. per ft. of pipe for 16-in. pipe, and 71 cts. for 18-in. pipe, which figures include freight and every expense. The length used on each pile varies from 2 ft. 6 ins. near the shore to 15 ft. on each pile, the piles being 50 to 60 ft. long.

A test pile infested with live teredos in a healthy state was treated in this way, and at the end of 24 hours it was found that the teredos were all dead and turned black. In 48 hours more the bodies of the worms had almost disappeared. At the end of a week the pile was pulled up and split in pieces, and nothing could be found except the holes which the teredos had left. We were, therefore, fully assured of the utter destruction of the teredo by this method and the sure protection of the pile.

In cutting off about 4,000 piles at both trestles, not one was found to be decayed, although they had been in place 14 years. This is a good record for yellow pine treated with dead oil creosote. All indications would show that they would be good for at least ten years of service. Untreated yellow pine piles would not last in this climate more than an average of seven years, assuming that the teredos did not eat them up in far less time.

SANITATION AND SANITARY APPLIANCES AT THE COLUMBIAN EXPOSITION.

In the Anthropological Building are interesting exhibits of statistics of mortality and disease, criminals, population, etc., shown both by figures and charts, and there are also models of hospital wards, prisons and other institutions. Ventilation, water supply and other matters of social and public interest are shown by maps, charts and statistics.

The Engle garbage cremator is in use on the grounds, consuming all the refuse from the Exposition, as described in our issue of March 23, 1893. Compressed air is used to spray the oil fuel used in the furnaces, instead of steam, as is common in connection with steam generating plants using oil as a fuel. The original intention was to use compressed air from the pipes supplying the Shone sewage ejectors, which deliver under pressure of about 100 lbs. per sq. in. The plant, as installed, however, uses air at low pressure, which is supplied by a Root blower driven by a 12 K-W. electric motor. The air pressure is about 1 lb. As much as 75 tons of garbage per day is reported as having been consumed in the cremators, including the sludge from the sewage purification works, described in our issue of Aug. 3, 1893.

There is also an exhibit, in the Anthropological Building, of the Davis garbage cremator, in which the gas and flame from the main fire pass over an evaporating pan, under and through the garbage grate, and then over a second fire to the flue. There is also a garbage storage vault, airtight, with high escape pipe for gases generated. The vault is above ground and has doors readily accessible for the collector. The Sanitary Garbage Pail Co., Detroit, Mich., has a V-shaped pail, hinged at its bottom to the fence or wall of the house yard. Normally it stands with one side flush with the fence or wall and the lid opening inside the yard. The garbage collector has a key which unlocks the fastening, allowing him to pull the pail outward, when he takes out the inner pail, empties it into the cart and after replacing it pushes the case back into position, when it is automatically locked. A hand cart for garbage, consisting of a galvanized cylindrical vessel on small wheels, is shown by the F. C. Austin Mfg. Co., of Chicago. Appliances for house ventilating, closet fittings, etc., are also shown. The Pacific Flush Tank Co., of Los Angeles, Cal., shows the Miller automatic siphon. There are three makes of portable disinfecting plants. The LeBlanc apparatus has a vertical boiler and horizontal cylindrical chamber carried on two wheels. Geneste Herscher & Co., of Paris, have a similar apparatus mounted on four wheels, and using direct steam under pressure. The third is a Russian plant of similar character. The U. S. Government exhibits also include the steam disinfecting plants in use at quarantine stations. A system designed to separate, and to some extent oxidize, solid and liquid house refuse is exhibited by M. P. Nadien, College Road, Harrow, England.

The State Boards of Health of nine states and some of the Provincial boards of Canada make exhibits designed to show wholly or in part the nature of their work. Aside from mortality and similar charts, diagrams, and statistics more or less common to these exhibits, some of the more strictly sanitary exhibits were as follows: Maine showed plans of schoolhouses, it having recently made special studies in this direction. Massachusetts had a very complete exhibit showing models of its experimental station and its various features, samples of filtered water with analyses attached, views of sewage purification works in operation in Massachusetts and a large map showing the normal chlorine of the waters of various parts of the state. Rhode Island has a topographical map of the state, and New York has various maps and views, including illustrations of a sanitary inspection of the Croton watershed, about 100 photographs and drawings of the new Croton aqueduct and maps of some sewerage systems.

New Jersey shows maps and details of several sewerage systems and a large map of the northern portion of the drainage area of the Passaic River, as prepared by the State Water Supply Commission. Pennsylvania exhibits portable cases containing apparatus for the chemical and biological examinations of domestic water supplies. Louisiana shows models of a system of maritime sanitation. Illinois has some maps and charts showing the intimate connection between the water supply and other unsanitary features of the city of Chicago and zymotic diseases, but it may be added that the city is making great improvements in this connection. Minnesota shows views of a garbage loading dump and a garbage train in transit to a truck farm.

In the Canadian section there is a model of a quarantine station on the St. Lawrence River and plans of the sewage farm at Berlin, Ont. (Eng. News, April 6, 1893), and of the sewage disposal works at the insane hospitals, in London and Mimico, Ont. There is also in this section of the building a large relief map of the drainage areas of the Boston water-works. The general arrangement of this department includes athletic training and gymnastic exercises for physical development and for the treatment of diseases, education, prison and reformatory methods, the care and treatment of the poor, the sick and the delinquent, etc., as already noted in a description of the scope of the bureau of hygiene. In the gallery is an interesting exhibit illustrating the relative measurements of various parts of the body, and the mean or average measurement representing the average man and woman of to-day. Instruments for noting and recording the delicacy of the senses of touch, sound, sight, memory, etc., also attract considerable attention.

Household Filters.—In the Anthropological Building a number of household filters are displayed, and it is interesting to note the continuous stream of people swallowing glassfuls of the crystal liquid which looks so attractive in the glass bowls and jars. Most of these filters are claimed to be germproof as well as dirtproof. In the Columbia filter (Columbia Automatic Filter Co., Washington, D. C.), the inflowing water passes up through an annular column of sand and percolates through the walls of a porcelain cylinder around which the sand is packed. The Success filter (Shepard & Sumner, New Orleans, La.) uses a hollow block of natural Tripoli stone which is seated on a tube, the bottom of the block being about an inch above the bottom of the filter chamber, thus allowing for settlement of dirt, etc. The stone is claimed to be impervious to germs and microbes as well as impurities of all kinds, so that the material can be washed from time to time and used indefinitely without becoming foul. The filter chamber has a capacity of four gallons, and a block 4 ins. diameter and 5 ins. high will filter eight to twelve gallons of ordinary water, or half that quantity of muddy water, daily. The Germproof Water Stone Filter Co. (Akron & Canton Stoneware Agency, Chicago) also uses natural Tripoli stone, from quarries in Indian Territory, but in the shape of a flat disk between the upper and lower chambers of the filter. The McConnell Filter Co., of Buffalo, N. Y., uses a bell-shaped vessel of silicious clay as a filtering medium, the water passing through from the outside, and the filters are made both for water with and without pressure. The Boston Filter Co. uses an unglazed porous porcelain tube as a filtering medium, and J. A. Bowden & Co., Detroit, Mich., makes stone filters which may be washed with filtered water and also filters of a large size for industrial purposes which might also be used to filter city supplies. In the latter alum is used as a coagulant and crushed quartz as a filtering material. The Cummings filter, made in Philadelphia, employs animal charcoal as a filtering material.

There are also distillation apparatus exhibited. In that of J. A. Bowden & Co., of Detroit, the steam from a lower vessel condenses on the conical bottom of the upper vessel filled with water, and drops from the point of the cone into a funnel in the lower chamber, a pipe leading from the funnel to the outside of the apparatus. In the Hunting automatic distiller (Dr. Nelson Hunting, Albany, N. Y.) the overflow from an upper condensing tank flows to the evaporating chamber, and the steam rises to the upper part of the chamber (to which air is admitted), and being condensed on the bottom of the upper tank the water falls upon a conical shield which sheds it into a gutter around the chamber, from which it is drawn off for use. The Pasteur-Chamberland Filter Co., of Dayton, O., has a "tourist" filtering apparatus fitted with a case 12 × 8 × 2¾ ins., which will filter about one gallon per hour. The filtering tube is placed in a jar of the water to be filtered and is sucked in through this tube by means of an air pump. The filtering method adopted by this company (and invented in the laboratory of Mr. L. Pasteur, of Paris, primarily for removing bacteria from liquids during experiments), consists in the use of porous filtering tubes of polished porcelain, through which the water passes under pressure or by gravity. The tubes are of specially prepared clay, baked at a very high temperature, and the water passes from the exterior to the interior, depositing impurities and micro-organisms on the outside. This filter is used in the free drinking water tanks within the buildings.

SCHENECTADY FREIGHT LOCOMOTIVES AT THE COLUMBIAN EXPOSITION.

The Schenectady Locomotive Works call attention to some errors in the list of dimensions of the two heavy freight engines illustrated last week. Some of these were typographical errors, but the others were originally made in the full table of dimensions in our issue of May 25, and as no correction was made at the time by the builders, these dimensions were presumed to be correct. The corrections are as follows:

Twelve-Wheel Locomotive, Duluth & Iron Range R. R.—Width of firebox, 3 ft. 5⅜ ins. (instead of 3 ft. 5⅝ ins.); depth of firebox, 5 ft. 5¾ ins. (instead of 5 ft. 2¾ ins.).

Consolidation Locomotive Mohawk & Malone R. R.—Length of firebox, 9 ft. 3-16 in. (instead of 9 ft. ⅜ in.); height from rail to center line of boiler, 7 ft. 2½ ins. (instead of 7 ft. 10½ ins.); heating surface of firebox, 168.2 sq. ft. (instead of 162.2 sq. ft.); total heating surface, 2,046.2 (instead of 2,040.2).

A 12-in. Harveyized steel plate, 13 ft. 6½ ins. long and 6 ft. 10½ ins. wide, was tested at Indian Head on Oct. 14. Two 8-in. shells, with initial velocities of 1,678 and 2,004 ft.-secs., were fired at the plate. The first shell penetrated about 4 ins., welding the point and shattering the rest of the shell. The second shot penetrated about 6 ins., leaving the point imbedded and breaking the rest of the projectile to fragments. No cracks appeared in the plate.

Corporations tearing up Chicago streets must thoroughly repair them, according to a late order of the corporation counsel. The official notification names 19 corporations that have torn up streets for laying telegraph, telephone and electric light wires, pipes for fuel, water and gas companies, street railways, etc. It is estimated that 1,364,000 sq. yds. of pavement are now in poor condition owing to these corporation works, and that it will cost $600,000 to make the repairs. The representatives of the corporations named are invited to attend at the office of the Commissioner of Public Works and enter into some arrangement for making these repairs, under penalty of not being permitted to open the streets for any purpose after Oct. 17. The damage seems to be chiefly due to careless back-filling and the consequent sinking of the paved surface.

Bids for gunboats 7, 8 and 9 were opened in Washington on Oct. 17. The lowest bid was made by the Newport News Shipbuilding & Drydock Co., at $290,000 for No. 7 and $306,000 for either Nos. 8 or 9, or $840,000 for the three vessels. The bids are given on page 324 of this issue. The general dimensions of the gunboats are as follows:

	No. 7.	Nos. 8, 9.
Length on load line.....	220 ft.	250 ft. 6 ins.
Maximum beam.........	36 "	49 ft.
Mean draft.............	11 "	8 ft. 10 ins.
Normal displacement....	1,261 tons	1,311 tons
" coal capacity.....	150 "	100 "
Full " "	380 "	275 "
Contract average speed..	14 knots	13 knots

No. 7 is a flush deck fore-and-aft schooner-rigged steel gunboat, with twin screws and two sets of vertical inverted, quadruple expansion engines. The battery will be made up of four 4-in. r. f. guns in the open, four 4-in. r. f. guns in armored sponsons, and four 6-pdr. Hotchkiss guns in 1-in. armored sponsons and 1-pdr. Hotchkiss and Gatling guns on the main deck. Nos. 8 and 9 are designed for duty in the rivers and shallow waters of China. These gunboats will have all steel hulls, specially shaped aft to adapt them to twin screws and to the service intended. They will have no sail power and only one military mast with a conning station in the mast accessible by a spiral stairway. The battery will consist of four 4-in. r. f. guns protected only by gun shields; four 4-in. guns and two 6-pdrs. in armored sponsons; two 6-pdrs. on forecastle deck and two more in the lower top; two 1-pdrs. on the bridge and two Gatlings in the upper top. The two engines will be of the vertical, inverted, direct-acting triple-expansion type.

The enforced use of water meters in all factories, refineries, hotels and other large business establishments is strongly recommended by Director Windrim, of the Philadelphia Board of Public Works. The recommendation is made necessary by the rapidly increasing demand for water in that city, and the shortness of supply in the summer months, as lately more fully stated in this journal. As usual, the movement meets with some opposition from newspapers and individuals who believe that water should be free to all, and that a meter is a tax upon an essential to health. In the limitations fixed by Mr. Windrim it looks to us rather as a very proper tax upon notoriously extravagant use and waste in the large establishments named. The domestic consumption is not interfered with and the owners of stables, the worst offenders of all, seem to be left out of consideration.

Te largest cargo steamer in the world is claimed to be the "Cevic," lately launched for the White Star Line by Messrs. Harland & Wolff, of Belfast, Ireland. The "Cevic" is 500 ft. long, 60 ft. beam, 38 ft. deep, with an estimated gross tonnage of 8,315, and net tonnage of 5,000 tons. The total capacity of the various holds is put down at 14,089 tons. She will be fitted to carry 800 head of cattle on the upper and bridge decks. She will have two sets of triple expansion engines driving separate propellers. She will join the White Star freight carriers, the "Bovic," "Tauric" and "Nomadic."

The oil-tank steamer "Batoum," of Hamburg, now loading in New York harbor, is 4,053 tons burden, and has a capacity of 2,700,000 gallons of oil, or 70,000 barrels in bulk. She made the trip to New York in 12 days and 6 hours, and is claimed to carry more oil than any steamer of her class by about 80,000 gallons.

The protected cruiser "Olympia," built by the Union Iron Works, of San Francisco, Cal., is to be officially tested at an early day. This vessel, authorized by act of Congress of 1888, is 340 ft. long on mean water line, 53 ft. beam and 21½ ft. draft. Her displacement at normal draft is 5,500 tons. She has a coal capacity of 1,300 tons and can steam 13,000 knots at a 10-knot rate. The protective deck is 4¾ ins. thick on the slopes and 2 ins. on top, over the machinery space, and 3 and 2 ins. forward and aft of this space. She has two military masts carrying sufficient sails to steady the ship. The main battery will consist of four 8-in. and ten 5-in. rapid-fire guns. The 8-in. guns are placed 26 ft. above the water line, forward and aft in 4-in. barbettes and hoods, and the 5-in. guns are mounted on the sides in 4-in. segmental shields. The secondary battery is made up of eight 6-pounders, six 3-pounders, and fourteen machine guns, with one Maxim and one 1-pounder Hotchkiss gun in each lower top. There are six torpedo-launching tubes. The machinery consists of twin screws, driven by two vertical direct-acting triple-expansion engines with 42, 59 and 92-in. cylinders, and 42-in. stroke. The estimated indicated horse-power of all engines, at 160 lbs. steam and 129 revolutions, is 13,500.

The 16¼-in. 110-ton naval gun is a thing of the past, says Lieut. E. F. Qualtrough, U. S. N., in summing up the past year's progress in naval ordnance for the Navy Department. The "Renown," the latest English battle ship now building, though she has a displacement of 12,350 tons, is to carry nothing larger than 10-in. 50-ton guns. Italy has adopted 13-in. 68-ton guns, and France is arming her new ships with 13.39-in. 77-ton guns 46½ ft. long. This gun is said to throw a 925-lb. projectile, with 440 lbs. of powder, with the enormous initial velocity of 2,600 ft. per second. Austria fixes her limit still lower with a 9¾-in. gun of 35 to 40 calibers in length. The reasons for this radical change in practice are based upon the proved liability of the long, heavy guns to droop at the muzzle and the instability of the ship consequent upon the weight of ordnance and requisite turrets placed high above the water line. The lighter guns have a sufficient power to penetrate any armor likely to be encountered and have the added advantage of being manipulated by hand should the mechanism be injured or fail. The United States has fixed upon a 12-in. gun as its maximum for the later battle ships.

The Maxim automatic 1-pdr. rapid-fire gun, of which France has lately ordered 150, is primarily designed for use against torpedo boats and lightly protected vessels. It is thus described by the U. S. Office of Naval Intelligence: The caliber is 1.457 ins. and the gun weighs complete 420 lbs. Both common and steel shells are used of 1 lb. and 1.07 lbs. in weight and from 3.63 to 3.59 ins. long. The bursting charge is 348 and 246 grs. in the two shells. The firing charge is 1.5 oz. of smokeless powder in a solid drawn brass cartridge case, the length of the cartridge case and shell complete being 6.42 ins. The muzzle velocity is 1,800 ft. per second, with a muzzle penetration of 2.25 ins. of wrought iron; and the shell will perforate 2.04 ins. of the same iron at 100 yds., and 1.25 ins. at 600 yds. The cartridges are fired from belts holding 25 or 50 rounds. The weight of the gun and mounting combined is 756 lbs.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago—Existing Roads.

ALTOONA & PHILLIPSBURG.—This road has been built from Phillipsburg, Pa., to Ramey, about 12 miles, except some 4,000 ft., which await a decision of the courts permitting the proposed crossing of the tracks of the Tyrone & Clearfield branch of the Pennsylvania R. R. The line has been located from Phillipsburg to Zanesville, a distance of 20 miles, and is parallel to the Tyrone & Clearfield road much of the distance. New year the road will probably be extended farther southwest to connect with the Altoona, Clearfield & Northern R. R., which is also controlled by S. P. Langdon, Philadelphia, the president of this company.

BALTIMORE & OHIO.—A report from Millersburg, O., states that the public improvement committee has completed arrangements with the Cleveland, Akron & Columbus R. R. Co. for the right of way of the B. & O. road building from Wooster to that city, for four miles immediately north from Clinton St. to the county infirmary. These four miles, under the arrangements, will be double-tracked, and work will be commenced at once. The other 14 miles to Wooster are now ready for the ties and iron. Arrangements have also been made for terminal facilities and a union station at Millersburg.

CENTRAL R. R. OF PENNSYLVANIA.—The main line of this railway, from Bellefonte, Pa., to Mill Hall, about 30 miles, has been all graded, and half of the track laid. It is thought that the road will be opened for traffic in December.

COLDWATER & MANSFIELD.—The Hillsdale, Mich., correspondent of the Detroit "Free Press" states that nearly 300 men and a large number of teams are at work on the line of this old road from Kunkle, O., and the roadbed will be ready for the iron to Pioneer, this week. From Pioneer, the surveyors have located a line directly west to Clear Lake, Ind.; thence north to Ray, from Ray through California township to Coldwater, Mich., striking the old Mansfield & Coldwater road soon after entering Branch county. This new line leaves Camden three miles to the north, and will not have a station in Hillsdale county. It is the intention of the company to build the line from Pioneer north to Hillsdale some time in the future, which would be a great thing for this city, and the county south of it, through which the road would pass, and which is now without railway facilities.

DELAWARE, LACKAWANNA & WESTERN.—A dispatch from Walkerville, Ont., states as follows: Hiram Walker has leased the London & Port Stanley Ry., and will continue it to Buffalo, making it the western connection of the Lackawanna road. Mr. Walker already owns the Lake Erie & Detroit River Ry., extending from Windsor east to Ridgetown, near St. Thomas, which will be a part of the new system. If the report proves correct, the Lackawanna in the near future will have a line across Ontario to the banks of the Detroit River, from which point it will make some arrangement for crossing the Michigan peninsular and entering Chicago.

NORTH BEND & KETTLE CREEK.—This railway has been completed, according to reports, from North Bend, Pa., to Cross Forks, about 12 miles north, and will be extended at once to coalfields near Kettle Creek, a distance of seven miles. Pres., F. A. Blackwell, Gleasontown, Pa.

OHIO SOUTHERN.—A ten-mile branch is being built at Wellston, Jackson county, to connect with coal mines, according to reports.

WILKES BARRE & EASTERN.—The last rail on this railway between Wilkes Barre, Pa., and Stroudsburg, 60 miles, was laid Oct. 11.

Projects and Surveys.

KINGSTON, SMITH'S FALLS & OTTAWA.—An election will be held at North Gower, Ont., Oct. 25, to vote on a bonus for the proposed railway between Kingston, Ont., and Smith's Falls, and thence to Ottawa. Other elections will soon be held in the district for this purpose, and it is reported that Thomas Nash will leave Kingston in a few days with a surveying party to lay out the route of the long projected road.

OHIO.—A conference was held at Cleveland last week between committees from the chamber of commerce and from Cadiz and St. Clairsville, O., with regard to a railway from St. Clairsville, through Cadiz to Valley Junction, where a connection would be made with the Valley Ry. The length of the road would be about 57 miles, and the estimated cost of construction $1,000,000. M. J. Brown, N. A. Hanna, Cadiz; John T. Trowl, Albert Lawrence, St. Clairsville; J. H. McBride, Cleveland; John A. Hamlon, Coshocton.

Southern—Existing Roads.

SEABOARD AIR LINE.—It is claimed at Atlanta, Ga., that this railway is to be extended to New Orleans and the Southwest. The line would run between the Atlanta & West Point R. R. and the Georgia Pacific Ry. a great part of the way, passing through Selma, Ala., and continuing above the Louisville & Nashville, and below the Georgia Pacific route to New Orleans.

TENNESSEE CENTRAL.—Arrangements have been made for putting between 300 and 400 convicts at work on this road near Standing Stone, Tenn., according to reports. The line will be built to connect with the Cincinnati Southern Ry., a distance of about 60 miles, as stated in our issue of last week.

Projects and Surveys.

ADDISON & CENTRALIA.—Incorporated in West Virginia to build a railway from Addison, Webster county, to Centralia; capital stock, $500,000; A. M. Lane, Joseph Fuccy, J. A. Fickinger and W. T. Taylor, Jr., Weston, W. Va.; C. P. Dorr, Addison, and John T. McGraw, Grafton; principal office, Centralia, W. Va.

Northwest—Existing Roads.

BLACK HILLS & FORT PIERRE.—It is reported that this company recently laid 10 miles of track in the Black Hills, S. Dak., and built 24 bridges, including trestlework, averaging 75 ft. each, in 7½ days.

CHICAGO, BURLINGTON & QUINCY.—It is stated at Deadwood, S. Dak., that the branch to Lead, which has not been operated for some time, will soon be rebuilt.

DULUTH & WINNIPEG.—Press reports state that this railway will be extended into the Red River Valley and also to Winnipeg, Man., next spring. Gen. Man., W. H. Fisher, Duluth.

DULUTH, RED WING & SOUTHERN.—Steps are being taken by citizens of Duluth to secure the early extension of this railway from Red Wing, Minn., to that city, a distance of 165 miles. The road has been in operation between Zumbrota, Minn., and Red Wing for over a year. Pres., T. B. Sheldon, Red Wing, Minn.

Projects and Surveys.

MISSISSIPPI VALLEY.—Incorporated in Illinois to construct a railway from East St. Louis, Ill., to Cairo, Ill., through the counties of St. Clair, Madison, Monroe, Randolph, Jackson, Union and Alexander; capital stock, $3,000,000; T. M. Chase, G. W. Killion, G. W. Chase, C. A. Gamlin and M. C. Pennell; principal office, East St. Louis, Ill.

Southwest—Existing Roads.

EXCELSIOR SPRINGS.—The first train passed over this road Oct. 10. It will be operated by the Wabash and extends from its station at Cooley's Lake, Mo., to Excelsior Springs, on the Chicago, Milwaukee & St. Paul Ry., a distance of about 10 miles.

MISSISSIPPI RIVER & BONNE TERRE.—This railway is being changed to standard gage and the bridges along the route strengthened. It extends from Riverside, Mo., to Doe Run, 47.47 miles, and is laid with 56-lb. steel rails. Gen. Supt., J. Burns, Bonne Terre, Mo.

Rocky Mt. and Pacific—Existing Roads.

COLORADO MIDLAND.—A press dispatch from Colorado Springs, Colo., dated Oct. 11, states as follows: One of the most marvelous engineering projects of modern times, the Busk-Ivanhoe Ry. tunnel, is practically completed. The headings will meet to-morrow or next day. To-day's record shows only 150 ft. of tunneling, or two weeks' work, yet remaining. The tunnel penetrates the continental divide of the Rocky Mountain range, a distance of 9,394 ft. west from Busk to Ivanhoe, on the Colorado Midland division of the Atchison, Topeka & Santa Fe R. R., 147 miles west of Colorado Springs. The tunnel was projected in 1888 to save 10 miles of steep mountain road. The Busk Tunnel Ry. Co. was incorporated in 1890, and on July 21 of that year the contract for construction was let to M. H. Keefe, Helena, Mont., who began work four days later. The total cost of the tunnel will reach $1,250,000. Ch. Engr., B. H. Bryant, Colorado Springs, Colo.

ELK MOUNTAIN.—S. E. Fulton, Denver, is reported as confirming the statements that negotiations are being made which will probably result in the completion of this railway. The line extends from Sands, on the Colorado Midland Ry., south to Marble, a distance of about 30 miles, and was graded last year.

MIDLAND TERMINAL.—H. Collbran has been East for some weeks and has telegraphed to Denver that the completion of this branch of the Colorado Midland R. R. to Cripple Creek, Colo., is assured. The road will be nearly 25 miles long, leaving the main line at Divide station. About eight miles of the road have already been graded and several bridges constructed. The rails have been ordered from the Bessemer works at Pueblo, and it is expected that the line will be in operation by Jan. 1.

NEVADA SOUTHERN.—Col. T. W. Brooks, Pomona, Cal., who is now in Nevada, has written to a San Francisco paper that the completion of this railway between Los Angeles, Cal., and Salt Lake City, Utah, has been decided upon. The first section of the road, between Blake, Cal., and Sunmit, 30 miles, was completed about two months ago.

Projects and Surveys.

BODIE RY. & LUMBER CO.—Incorporated in California, Oct. 5, to manufacture lumber and to operate a railway; principal office, San Francisco.

FLORENCE & CRIPPLE CREEK.—D. H. Moffatt, Pres. First National Bank, Denver, has started for New York to place the bonds necessary to build this railway from Florence, on the Denver & Rio Grande R. R., to Cripple Creek. The route was surveyed several months ago and everything made ready for grading. The line will be about 40 miles long and the construction will be commenced as soon as possible. The road will probably become a part of the Denver & Rio Grande system.

PORTLAND & MOUNT HOOD.—O. C. Yocum, Portland, is engaged in surveying a line for this proposed railway. The Construction Co. & Center Bearing Ry. was organized in Portland, Ore., several months ago to build a railway between that city and Mount Hood, having a standard gage roadbed with center elevated rail.

Foreign.

SYRIA.—We stated last week that the contract for the Syria-Ottoman R. R. had been awarded to a Chicago firm. Huss, Townsend & Co. were the successful bidders, and the original contract, signed Sept. 13, is stated as for $5,760,000, though it is probable that the outlay will be several times that amount. The contract includes the complete equipment of the road, which will be 150 miles long and will pass over the plain of Esdraelon, skirt the Sea of Galilee, cross the Jordan, going through Damascus to Haifa and Acre. Five miles of track have already been completed and the entire work will be pushed as rapidly as possible, being turned over in sections of 25 miles each.

SOUTH AFRICA.—A correspondent writes us that the Beira Ry. Co. has built about 60 miles of its proposed railway from Beira, on the southeast coast of Africa, across Portuguese territory to the eastern frontier of British territory to open up communication with the coast for the Mashonaland gold fields. The gage is 2 ft. 6 ins. and the contract for the first 75 miles of the road was awarded about a year ago, as stated in our issue of Nov. 24, 1892. The road will probably be completed to Chemoyo as soon as possible and a short rest may then be taken before going further. It is the intention to extend it to Salisbury and Victoria, but there is small prospect of its being built that distance at present. As soon as the railway is completed to Chemoyo heavy goods can be landed at Beira, transported by lighters some 35 miles to Tontesville and then by railway to Chemoyo, from which place transportation to Salisbury and Victoria would be by ox wagons. At present the railway is not carrying freight and it has to be taken in small bundles, weighing about 50 lbs. each, by native carriers to Chemoyo, as the region between that place and the coast is infested with a fly whose sting is deadly to all beasts of burden.

STREET RAILWAYS.

SOUTHBRIDGE, MASS.—Frederic D. Fisk, Pres., Southbridge, Sturbridge & Brookfield R. R. Co., has been authorized to employ an engineer to examine the surveys and estimate the cost of the proposed electric railway to east Brookfield.

WARWICK, R. I.—The town council has approved the plans of the Pawtuxet Valley Electric R. R. Co. for its proposed route through the town.

NIAGARA FALLS, N. Y.—It is reported that the horse car line from Clifton to Drummondville, in Ontario, will be changed to an electric railway and that important extensions will be made. The capital stock of the company will be increased from $50,000 to $300,000.

NORRISTOWN, PA.—Plans are being considered, according to reports, for changing the Roxborough Inclined Plane Ry. to an electric railway next year. The Citizen Ry. Co. will probably extend its line to Conshohocken, and this with other electric railways now under construction or projected will give an electric railway all the way between this city and Philadelphia.

BALTIMORE, MD.—The "Sun" states that the Baltimore, Middle River & Sparrow's Point R. R. Co. will protest to the county commissioners against permission being given to the Canton, Sparrow's Point & North Point R. R. Co. to lay tracks on the streets named in the petition to the commissioners unless the company conforms to the grades of the streets. The plans presented include an elevated track for about a mile. The Baltimore, Middle River & Sparrow's Point Co. will be ready to commence building its road in about a week.

SANDUSKY, O.—The Sandusky, Milan & Norwalk Electric Ry. has been completed and the project of building an independent line from Huron to Hull's Corners is being discussed by Huron capitalists, according to reports. Should this road be built it is thought probable that it would be extended and that this city would soon have electric railway connections with Vermillion, Ceylon and Berlin Heights.

DETROIT, MICH.—The "Free Press" states that the extension of the Detroit, Wyandotte & Trenton Electric Ry. to Toledo is assured and that there is a company formed for the construction of a similar line which will, if built, be located about an average of one mile further back from the river than the first, traversing Fort St. from the Eureka road at Wyandotte to Detoit.

CHICAGO, ILL.—Siemens & Halske, of Berlin, are reported as interested in a new rapid transit enterprise on the North Side. The company is to be known as the North Chicago & Suburban St. Ry. Co.; capital stock, $5,000,000. Others interested are O. W. Meysenburg, John P. Hand, A. C. Bauman and Ernest Hermann. The system to be used is similar to that at Buda-Pesth and exhibited at the World's Fair.

CARTHAGE, MO.—Three companies have applied for a franchise for an electric railway to Cartersville.

GUTHRIE, OKLA.—A press report states that the Enid & Perry Ry. Co. has been chartered with a capital of $500,000, the incorporators being E. L. Dunn, R. W. Patterson, C. O. Wood and J. W. Thompson, of Enid, and James A. Pearce, of Denver, Colo. The company is organized to build an electric railway between the cities of Enid and Perry, in the Cherokee strip, a distance of 40 miles, and work will be commenced at once.

LOS ANGELES, CAL.—The franchise for an electric railway from Pasadena Ave. and city limits to South Pasadena has been awarded to W. D. Larrabee, work to be commenced within 90 days and completed within a year.

OAKLAND, CAL.—It is reported that a survey is being made for an electric railway from the terminus of the Piedmont cable road at Blair Park by way of Walnut Creek and Lafayette, to the Moraga grant. About two years ago the Oakland end of this route was surveyed by the county surveyor, and found to be practicable for such a railway, though in places a 7% grade would be necessary.

HIGHWAYS.

PENNSYLVANIA.—The borough council of Rutledge has awarded a contract for constructing telford roads to W. T. Hall, Springfield, at upward of $10,000.

BRITISH COLUMBIA.—The Spokane, Wash., "Chronicle," states that the British government will build a good road into the Boundary Creek mining district. The route has been surveyed and is reported by J. C. Haas, who has just returned from the district, as following the old Providence trail from Grand Prairie to Boundary Falls.

BRIDGES AND TUNNELS.

BOSTON, MASS.—The department of parks will receive bids until Oct. 23 for a stone bridge on the bridle path near Audubon road.

FITCHBURG, MASS.—Bids were opened Oct. 12 for a bridge on River St. It will have a 35-ft. roadway and two 5-ft. walks, the length of span being 98 ft. in the clear. The bids were as follows: Dean & Westbrook, $7,600 for a truss bridge; Groton Bridge & Mfg. Co., $7,294 for a truss or $10,987 for a plate girder; Wrought Iron Bridge Co., $7,700 or $11,950; R. F. Hawkins Iron Works, $7,847 or $11,678; Berlin Iron Bridge Co., $7,906 or $11,810. The contract was awarded to the Groton Bridge & Mfg. Co., at $10,987 for a plate girder bridge. David A. Hartwell, Cy. Engr.

NIAGARA FALLS, N. Y.—The commissioners of the Niagara reservation have decided on the plans for a new iron bridge from Luna Island to Goat Island, to be built this winter.

PITTSBURG, PA.—It is stated that the bridge between Homestead and Braddock, the building of which has been in contemplation by the Carnegie Steel Co. for about two years, will probably be erected next year. The plans for the structure have been prepared for several months.

ST. ANDREW'S BAY, FLA.—The bridge over Wetappo Creek on the line between Washington and Calhoun counties has been washed away, and the commissioners will probably build a better bridge.

LOUISVILLE, KY.—The "Courier-Journal" states that the probability of another bridge across the Mississippi River at or near East Carondelet, Ill., is again being discussed in railway circles and that it is thought that plans are being matured for its construction.

DAYTON, O.—The covered bridge between Carlisle and Franklin, about 19 miles south of this city, which carried the Cincinnati, Hamilton & Dayton R. R. across the Miami River, was totally destroyed by fire Oct. 6.

LITTLE ROCK, ARK.—The county levying court has accepted the proposition of the Little Rock Bridge & Terminal Ry. Co. to build a free bridge across the Arkansas River at this place, referred to in our issue of last week. The county is to be given the free use of the bridge for foot and wagon passengers and is asked to pay $200,000 in 10 annual installments of $20,000 each toward the construction of a $225,000 bridge. The Little Rock & Memphis Ry. Co. agrees to pay $25,000 a year for right of way over the bridge.

CENTREVILLE, TEX.—The commissioner's court has awarded the contract for building bridges in this (Leon) county for the next two years to J. K. McClure, of Robertson county.

CROCKETT, TEN.—Bridge No. 86 over Hurricane Bayou, two miles north of this place, was burned Oct. 11.

GALVESTON, TEX.—There is a project reported as under consideration for a bridge company to build a double-track steel bridge across the West Galveston bay; estimated cost, $700,000.

NEW CASTLE, COLO.—The commissioners of Garfield county will soon commence work on a bridge across the Grand River near this place.

SOUTH LAKE, P. E. I.—Bids are asked until Oct. 25 for a bridge across South Lake in Kings county. D. J. McDonald.

BERN, SWITZERLAND.—The contract for boring the Simplon tunnel through the Alps has been awarded by the Jura-Simplon Ry. Co. to the Brand Co., of Hamburg, and Locher & Co., of Zurich, according to reports. It provides for a tunnel with a single line of rails, to be finished in 5½ years, and for the widening of the tunnel with a second line of rails, to be completed four years later. The total cost of the work is estimated at from $15,000,000 to $20,000,000. This tunnel will be over 12 miles in length and will be the longest in the world. It was described in our issues of July 28, 1892, and Sept. 15, 1892.

WATER-WORKS.

BATH, ME.—Surveys are being made by Chas. A. Corliss for an 18-in. main from Wequasset Lake to the city. The pipe will probably be laid this winter.

LISBON CENTRE, ME.—H. C. Spear will build a reservoir and erect a windmill and pump to furnish the village with spring water.

PETERBORO, N. H.—The town officials are investigating the question of a supply.

BURLINGTON, VT.—Eight bids were received for the proposed extension of the intake into the lake, and all were rejected as unsatisfactory. The lowest were Thatcher & Breymann, Toledo, O., $56,919, and J. G. Falcon, Evanston, Ill., $57,936, and the highest was $145,000.

EASTHAMPTON, MASS.—A special town meeting was called for Oct. 17 to consider extensions in several streets.

FAIRHAVEN, MASS.—The construction of works has been temporarily stopped, awaiting the awarding of certain contracts, for which the bids received were reported as too high, according to reports.

MARBLEHEAD, MASS.—The Marblehead Water Co. is looking for an additional supply.

MARLBORO, MASS.—J. F. Bigelow has prepared plans for a reservoir near Wayside Inn, for S. H. Howe, the proprietor of the place. The plans include a dam 240 ft. in length.

MEDFORD, MASS.—The mayor has recommended that $10,000 be appropriated for a pumping station at Wright's Pond, as requested by the board.

SOUTHBRIDGE, MASS.—The Water Supply Co. has voted to increase its capital stock from $30,000 to $40,000 to provide for an increased supply.

SOUTH FRAMINGHAM, MASS.—There is talk of calling a special meeting to consider the extending of the works to Lakeville, about 30 families there desiring the service, according to reports.

WOONSOCKET, R. I.—Sites are being considered for a new storage reservoir. The mayor is reported as saying that at the next session of the legislature the city will petition for authority to issue $100,000 of water bonds.

NEW BRITAIN, CONN.—The city is negotiating for the sale of the second $100,000 of water bonds.

NEW YORK, N. Y.—The department of public works will receive bids until Nov. 13 for pumping engines, boilers and appurtenances for the high service works at the new acqueduct, between Tenth Ave. and Harlem River.

SYRACUSE, N. Y.—The contract for trenching and laying pipe in East Genesee St. and Midland Ave. has been awarded to R. H. Harrison & Son, Newark, N. J., at $12,289. The contract for pipe is noted under Contract Prices.

GLEN GARDNER, N. J.—The Glen Gardner Water Co. has been incorporated to secure a supply from springs; Pres., Peter Martenis; Treas., Victor Castner.

ORANGE, N. J.—The committee has recommended that all bids for a 1,500,000-gallon pumping engine be rejected, and that bids be asked for a 3,000,000-gallon engine.

ALLENTOWN, PA.—The council has engaged J. Herbert Shedd, Providence, to report upon proposed extensions.

BELLWOOD, PA.—The Bellwood Water Co. has submitted a proposition to furnish a supply.

CLEARFIELD, PA.—The contract for works has been awarded to H. H. Malone, Hollidaysburg. About five miles of pipe will be laid.

HARRISBURG, PA.—Bids are asked until Oct. 23 for laying a 6-in. pipe in two streets. E. Mather, Pres. Bd.

KITTANNING, PA.—A subscription paper is being circulated with a view to securing works.

LACEYVILLE, PA.—John Mingos, R. H. Ely, John Vandervort and others will apply Oct. 20 for a charter for the Citizens' Water Co. to secure a supply for this place.

LIGONIER, PA.—Surveys will be made at once. The proposed supply will be from the mountains above Laughlinstown. Geo. Senft and J. M. Graham have been appointed to secure information relating to works.

PEN ARGYL, PA.—The citizens will vote at the next election on an issue of bonds for $30,000 for works.

WAMPUM, PA.—It is proposed to build a reservoir and secure a supply from springs.

WEST CHESTER, PA.—The committee has been authorized to advertise for bids for the excavation of a settling basin to cover one acre; depth, 5 ft.

ANNAPOLIS, MD.—Jas. M. Monroe, Secy., has been directed to advertise for an expert engineer to examine the works and report upon the needed improvements.

BERKLEY, VA.—The Berkley & South Norfolk Electric Light & Water Supply Co. has been reorganized; capital stock, $150,000.

ROME, GA.—The city has purchased two 100-HP. boilers of Walsh & Weidner, Chattanooga, Tenn.; valves of the Ludlow Valve Co., Troy, N. Y.; and 16-in. pipe of the Chattanooga Pipe Works. The two pumps are expected Nov. 1. The mains will be extended to North Rome.

DANVILLE, KY.—It is reported that Ben. Roach, Lexington, and Chas. Geffinger, Harrodsburg, are interested in organizing a company to submit a proposition for putting in works. Chester B. Davis, reported that works would cost $95,000, as stated in our issue of Sept. 14.

MORGANFIELD, KY.—The Dupont Improvement Co. is preparing plants for works. The supply would be from wells and pumped to a stand-pipe.

SPRINGFIELD, KY.—An effort is being made to secure funds for raising the dam of the fair ground pond to secure a supply for both domestic and fire purposes.

BRILLIANT, O.—The citizens will soon vote on works to cost $3,000, according to reports.

HILLSBORO, O.—The council has sold $75,000 of water-works bonds to the Atlas National Bank, Cincinnati, for $75,025.

STEUBENVILLE, O.—It is stated that the question of issuing bonds for new works will be voted on next month.

WEST CLEVELAND, O.—Bids are asked until Oct. 24 for laying 2,200 ft. of 6-in. pipe. J. D. Senn, Chn. Bd.

GREENFIELD, IND.—Harry Strickland, Cy. Clk., informs us that the city will probably engage an engineer this week to make plans. The water will be pumped to a reservoir; estimated cost, $30,000; population, 4,000.

NEW HAVEN, IND.—The city has voted in favor of works, but has done nothing further; population, 1,100. S. J. Stocks, Vil. Clk.

EATON RAPIDS, MICH.—An election will soon be held to vote on an issue of bonds for $39,000 for works.

HOUGHTON, MICH.—Bonds for $10,000 were recently voted to extend the works to East and West Houghton and construction will soon be commenced.

SAGINAW, MICH.—The city has sold $25,000 of water bonds for $28,037, according to reports.

DUNDEE, ILL.—The Dundee Water Co. has been incorporated by D. H. Hager, E. C. Hawley and C. H. Griffith and will petition for a franchise, according to reports.

BERLIN, WIS.—The city engineer will soon submit plans for works.

SOUTH MILWAUKEE, WIS.—The committee will receive bids until Oct. 21 for two 75,000-gallon pumping engines, 52 double 2½-in. nozzle hydrants, 27 double gate valves, 2 horizontal 10-in. check valves, 600 tons 4 to 12-in. pipe, 27 tons specials, intake, tank, etc., as stated in our advertising columns last week. Dousman & Sheldon, Engrs., Milwaukee.

GRINNELL, IA.—The city is reported as to put in works next spring; estimated cost, $30,000.

MARSHALLTOWN, IA.—It is reported that bids are about to be asked for a 3,000,000-gallon pumping engine.

WILLIAMSBURG, IA.—Bonds for works have been sold and work will be commenced on the plant. A large tank and a pumping engine will be required.

MINNEAPOLIS, MINN.—The intake pipe at the North Side station is to be extended about 400 ft. into the river and the work will soon be advertised. The old intake is of brick, but the extension will be of iron; estimated cost, $10,000.

LAWRENCE, KAN.—A new supply has been proposed by Holland Wheeler from wells to be sunk at North Lawrence.

NEWTON, KAN.—The council is considering the issue of bonds for new works, the supply furnished by the Newton Water Co. being unsatisfactory.

LINCOLN, NEB.—An election will soon be held to vote on extensions estimated to cost about $17,500.

OMAHA, NEB.—Herman Kountze, Frank Murphy and G. C. Barton are members of a commission appointed for three years to have charge of the construction of the proposed canal, employing engineers, etc. Andrew Rosewater, Consult. Engr.

PENDER, NEB.—M. N. Mussay, Cy. Clk., informs us that the bonds for proposed works have been declared illegal.

BROOKINS, S. DAK.—A pump will be purchased for the state agricultural college.

MADISON, S. DAK.—At an election Oct. 11 the city voted to issue bonds for $30,000 for works.

INDEPENDENCE, MO.—The Independence Water-Works Co. is considering an increase to the capacity of the pumping plant.

GALVESTON, TEX.—The committee on supplies has been directed to correspond with pump manufacturers for a pump for the storage tank.

GEORGETOWN, TEX.—W. N. Coler & Co. have purchased the works and will reduce the price to consumers 25%, according to reports.

HILLSBORO, ORE.—The Hillsboro Electric Light & Water Co. has been incorporated with a capital stock of $40,000.

ESCONDIDO, CAL.—The capacity of the works is to be considerably increased. The supply is from wells.

KELSEYVILLE, CAL.—The Kelseyville Water Co. has been incorporated by Cornelius E. Davis, St. Helena; Jas. H. Brown, L. Henderson and others of this city; capital stock, $20,000.

LOS ANGELES, CAL.—The committee is negotiating with Messrs. Pierce and Shaffer, Indianapolis, who hold an option on the works, for the purchase of all property and franchises of the City Water Co., Crystal Springs Co. and Citizens' Water Co. The lowest price named is $3,300,000.

OAKLAND, CAL.—The committee is advertising for plans or suggestions for a supply. W. G. Manuel, Chn.

SALT LAKE CITY, UTAH.—The superintendent has reported that owing to the grading of streets about 17,690 ft. of pipe will have to be lowered before frost sets in; estimated cost, $28,000.

TORONTO, ONT.—The city engineer has decided that the present system is the best, and it is reported that he will soon recommend the construction of a tunnel 2½ miles long under the bay; estimated cost, $500,000.

AYLMER, QUE.—The town council has decided in favor of works, subject to a vote of the taxpayers.

MONTREAL, QUE.—Bids will soon be asked for boilers, 600 HP.; estimated cost, $12,000. The council has voted to purchase a Worthington pumping engine, now at the World's Fair.

ARTESIAN WELLS.

STAUNTON, VA.—It is reported that the council will sink additional artesian wells.

RAPID CITY, S. DAK.—C. S. Fassett, State Irrigation Engr., Hichcock, has been in the city locating for two artesian wells which have been petitioned for.

IRRIGATION.

DAYTON, WYO.—The Sheep Creek Flume Co. has been incorporated with a capital stock of $15,000 to build a flume from the forks of the Sheep River, in Sheridan county, to the Tongue River, 4½ miles east.

SARATOGA, WYO.—It is reported that Colorado capitalists contemplate building an irrigation ditch on the east side of Grand Encampment River in the southern part of Carbon county, which will irrigate from 20,000 to 30,000 acres of fine agricultural land. Howard & Allen recently made a survey of the ground and are satisfied that the scheme is entirely practicable.

NEW CASTLE, COLO.—P. C. Coryell is reported as manager of a company planning to construct an irrigation ditch eight miles long near this place, work upon which will be commenced at once.

TACOMA, WASH.—C. H. Leadbetter, Man. Prosser Falls & Priest Rapids Irrigation Co., has awarded the contract for the completion of the company's irrigation system to C. W. Everest & Co., Portland, at about $200,000. The work will be commenced at once and is to be completed by next March. It consists of finishing the Kennewick branch of the canal from the crossing of the Yakima River to below Kennewick, a distance of 25 miles. The Priest Rapids branch will then be built from the river crossing north to White Bluffs, on the Columbia River, a distance of 40 miles, making the entire system of canals 85 miles long. The first 20 miles from Prosser Falls, where water is taken from Yakima River, to the river crossing, is finished.

ONTARIO, ORE.—The contract for the second section of five miles of the Owyhee irrigation ditch has been awarded to Kiesel, Shilling & Danilson, Salt Lake City. This ditch will take water from the Owyhee River nearly 25 miles distant and will bring it to the higher lands of the Snake River valley as far northward as the Malheur River, near this city. The first section is about completed, and the contract for the third section of five miles has been awarded to J. T. Clement. Section 2 will be 17 ft. wide on the bottom and 3 ft. deep, and section 3 will be 13 ft. wide and 3 ft. deep, both sections to be completed by April 1, 1894.

SAN BERNARDINO, CAL.—Press reports state that it is proposed to reclaim a large area of the Mojave desert in the vicinity of Daggett by means of a dam across the Mojave River and a submerged flume for the purpose of tapping the underflow. The initial point of the work is on the north bank of the river about four miles above Daggett. Two water rights have been located and filed with the recorder of this county, one claiming 100,000 miners' inches, and the other 1,000,000 inches of the unappropriated water of the Mojave River. A canal will be constructed 100 ft. wide at the bottom, 150 ft. on top, 10 ft. deep and having a grade of 3 ft. to the mile.

SALT LAKE CITY, UTAH.—The "Tribune" states that the Castle Valley Land & Canal Co. has written a letter to W. E. Hubbard, president of the chamber of commerce, stating that it proposes to build a canal 35 miles long and of sufficient size to irrigate 100,000 acres of land in Pine River Valley and Miller's Flat. It will leave Pine River near Helper and follow a southeasterly direction and will irrigate a strip 25 miles long by from 4 to 10 miles in width. The company has also surveyed for a reservoir in Gooseberry Valley that will cover 800 acres and will irrigate several thousand acres of land. Another scheme it has is to turn the water of the Strawberry River into Pine River to increase the supply of the latter stream. It also has a survey running into Pine River above Pleasant Valley Junction.

SEWERS.

NEWPORT, N. H.—A petition is being circulated for a special town meeting to consider the question of a system.

LAWRENCE, MASS.—The aldermen have unanimously passed the $50,000 sewer loan ordinance, over the mayor's veto.

LEOMINSTER, MASS.—The town has voted $6,000 for sewers in several streets.

WORCESTER, MASS.—The committee has recommended orders for 670 ft. of brick and 3,570 ft. of pipe sewers; also voted to put in an electric light plant and to enlarge the laboratory at the Quinsigamond purification works.

BUFFALO, N. Y.—The board of public works has been directed to advertise for bids for several brick and tile sewers.

CANASTOTA, N. Y.—Bids are asked until Oct. 26 for a sewer in this place. Edward Hannan, Supt. Pub. Works, Albany.

NEWBURG, N. Y.—D. J. Coutant, Cy. Clk., informs us that the contract for a sewer in West Newburg has not yet been awarded. The total bids are reported as follows: M. Sullivan & Co., Little Falls, $109,054; J. T. Rowland, Jersey City, $149,383; Stewart & McDermott, New York, $146,689; J. M. Brosnan, Westfield, Mass., $139,245; T. M. Lesher & Son, Easton, Pa., $162,192; Patrick P. O'Hehir, Warwick, $133,598; Babcock, Lary & Co., Newburg, $125,127; Wm. E. Dean, New York, $127,801; P. F. Brennan, New York, $187,884; Geo. S. Good & Co., Lock Haven, Pa., $168,328; A. M. Newton, Orange, N. J., $184,565; Inman Bros Const. Co., New York, $171,396; Reynolds & Conway, Newark, N. J., $178,469; Troy Public

Works Co., Troy, $190,216; Wm. McMeekin, Newburg, $150,846.

NEW YORK, N. Y.—The department of public works will receive bids until Oct. 23 for three sewers.——Bids are asked until Oct. 24 for two sewers. L. F. Haffen, Comr. St. Impvts., Wards 23 and 24.

NORTH TONAWANDA, N. Y.—The contract for sewers in two districts has been awarded to Beckrich & Lenz, Tonawanda, at $43,336.

SKANEATELES, N. Y.—The water board of Syracuse has submitted a proposition to the village authorities which includes the building of 18,000 ft. of 30-in. brick sewer.

BRUSHTON, PA.—An election will be held Nov. 7 to vote on an issue of bonds for $50,000 for a system. C. M. Logue, Burgess.

LOCK HAVEN, PA.—Voorhees & Witmer, Buffalo, N. Y., have been engaged to prepare plans for a complete system.

MEADVILLE, PA.—Bids ar asked until Oct. 23 for 800 ft. 12-in. and 1,600 ft. 15-in. pipe sewers, average cut 8 ft. W. A. Doane, Cy. Engr.

PHILADELPHIA, PA.—About 20 sewers are reported as under construction with other contracts soon to be awarded.

READING, PA.—The council has appropriated $100,000 for house drainage and the city engineer will soon receive bids for the work.

WASHINGTON, D. C.—The commissioners have decided to recommend an issue of bonds for $7,500,000, of which $5,000,000 would be for sewers.

MACON, GA.—Plans for a sewerage system for Vineville, a suburb of the city, were prepared nearly a year ago by C. W. Hendrick, Cy. Engr., as noted in these columns at that time. The population of Vineville is about 4,500 and application will be made at the next session of the legislature for incorporation as a town in order that bonds may be issued for sewers and other improvements, according to reports; estimated cost of sewers, $110,000.

COVINGTON, KY.—The lowest bids for the Willow Run sewer were as follows: Section 1, Patterson & Shipley, Catlettsburg, $43,319; section 2, Meyers Bros., Covington, $46,074. The prices are considered very low.

EVANSVILLE, IND.—The board of public works will receive bids until Nov. 4 for a local sewer.

INDIANAPOLIS, IND.—The board of public works will receive bids until Oct. 27 for a main sewer.

PONTIAC, MICH.—The city engineer, who was instructed to investigate the question of an outlet sewer, has reported that a closed sewer can be constructed for $20,000, while to use the river, paying $25,000 for the knitting-works dam, would cost $41,000.

CHICAGO, ILL.—Bids are asked until Oct. 26 for several sewers. H. J. Jones, Comr. Pub. Wks.

PORTAGE, WIS.—Efforts are being made to secure a complete system.

TOPEKA, KAN.—The contract for a sewer in district No. 16 has been awarded to C. J. Rosen, at $4,884, the other bids being Baker & Barnes, $5,139; Christian States, $5,424; Ritchie & McNair, $5,043; engineer's estimate, $5.920.

FRESNO, CAL.—Plans for additional sewers have been prepared by J. C. Shepard, Cy. Engr. The plans include 1,460 ft. 14-in. pipe sewers, at $1.15; 2,400 ft. 12-in., at $1.10; 3,000 ft. 10-in., at 90 cts.; 7,360 ft. 8-in., at 55 cts.; 30 manholes, at $50; total, about $14,000.

SAN FRANCISCO, CAL.—Marsden Mauxon and C. E. Grunsky, the board of engineers to devise plans for a system of sewerage for the city, have presented their last report and the board been dissolved by the supervisors. The work already accomplished has received the commendation of the grand jury and of the local press, according to reports, and its discontinuance is supposed to be in the interests of economy.

AYLMER, QUE.—The council has voted in favor of a system of sewers, subject to a vote of the taxpayers.

STREETS.

BOSTON, MASS.—The mayor has suggested an additional loan of $250,000 for constructing Commonwealth Ave.

FITCHBURG, MASS.—The superintendent of streets has been directed to make the necessary changes in River, West, Kimball and Cleghorn Sts. in accordance with the decree of the commission on grade crossings, and the work will be commenced at once; estimated cost, $20,000. David A. Hartwell, Cy. Engr.

TROY, N. Y.—The lowest bids for grading Fifteenth St. was that of Martin Murray, at $22,800, the highest bid being $29,950.

NEW YORK, N. Y.—Bids are asked until Oct. 24 for grading, etc., and until Oct. 26 for flagging and paving with trapblocks. L. F. Haffen, Comr. St. Impvts. Wards 23 and 24.

HARRISBURG, PA.—Bids are asked until Oct. 24 for grading Crescent St. from Swatara to Berryhill Sts. A. U. Zarker, Comr.

BALTIMORE, MD.—Ordinances have been signed for paving with granite blocks estimated to cost $40,000.

WASHINGTON, D. C.—The commissioners have decided to recommend an issue of bonds for $2,500,000 for street improvements.

NORWOOD, O.—Bids are asked until Nov. 13 for $10,322 of street improvement bonds. W. E. Wichgar, Clk.

FOND DU LAC, MINN.—The citizens have authorized an issue of bonds for $10,000 for public improvements, and bids are asked until Oct. 30 for the bonds. W. H. Hollenbeck, Vil. Recorder.

MINNEAPOLIS, MINN.—The proposed Minnehaha boulevard along the river bank is estimated to cost $255,877. Park bonds will probably be issued to commence the work.

KANSAS CITY, MO.—The city engineer has prepared a list of streets to be paved as soon as the necessary ordinances have been passed.——The proposed paving of Grand Ave. from Ninth to Twentieth St. with asphalt is estimated to cost $2.65 per sq. yd., or about $88,000.

ST. CHARLES, MO.—All bids for paving Main St. have been rejected. The city engineer will receive bids until Oct. 31 for furnishing macadam for improving Third St.

PETALUMA, CAL.—The Petaluma Paving Co. has been incorporated; capital stock, $30,000.

ELECTRIC LIGHT AND POWER.

NORTHAMPTON, MASS.—The Northampton Electric Light Co. is reported as about to advertise for bids for a new plant estimated to cost $30,000. The buildings will be of brick and stone and there will be three engines, aggregating 750 HP., and four boilers.

HOMESTEAD, PA.—The council is considering the advisability of putting in an electric light plant in connection with the water-works.

HILLSDALE, MICH.—The Jonesville Electric Light & Power Co., Jonesville, has offered to furnish 45 or more arc lights for five years, at $60 per light per year for lights to burn from half an hour after sunset until 1 o'clock every night in the year, or $70 per light for lights to burn all night.

TOPEKA, KAN.—The time for receiving bids for a water power and electric light plant on the Kansas River, recently advertised by the Chicago-Topeka Light, Heat & Power Co., has been extended from Oct. 18 to Oct. 28, and the time for beginning work correspondingly extended. Pres., E. C. Gibson, 1169 Rookery Bldg., Chicago.

GEORGETOWN, TEX.—W. N. Coler & Co. have purchased the city water-works and will put in an electric light plant, to be in operation by Jan. 1.

SAN BERNARDINO, CAL.—The trustees are considering asking for bids for lighting the city.

FREDERICTON, N. B.—The city council has voted to contract with the Fredericton Electric Light Co. for 50 arc lights of 1,200 c. p. each, at $2,950 per year, the contract to run 10 years. It is expected that the lights will be in operation in two months.

HALIFAX, N. S.—The council has awarded the following contract to the Illuminating & Motor Co. for three years: 100 arc lights, 2,000 c. p., $78.75 per light per year; 50 arc lights, 1,200 c. p., $72.75; 50 incandescent lights, 50 c. p., $23.87; 50 incandescent lights, 32 c. p., $17.52.

NEW COMPANIES.—Green Electric Signal Co., Kittanning, Pa.; $5,000; M. D. Wyman, Ford City; W. Reynolds, C. C. Shadle, Kittanning.——Eureka Brick, Tile & Electric Co., Eureka. Ill.; $50,000.

CONTRACT PRICES.

PIPE.—Syracuse, N. Y.—Bids were opened Oct. 6 for the following amount of cast iron pipe: 36-in,, 200 tons; 30-in., 20 tons; 24-in., 16 tons; 20-in., 195 tons; 16-in., 320 tons; 12-in., 10-in., 8-in. and 6-in., 5 tons of each; 4-in., 1 ton; special castings, 85,000 lbs. The contract was awarded to R. D. Wood & Co., Philadelphia, at $20.84 per ton for the pipe and 2.24 cts. per lb. for the special castings, the other bids ranging from $21.25 to $23.80 and from 2 cts. to 2.5 cts. W. R. Hill, Ch. Engr. Water Bd.

ASPHALT PAVING.—Denver, Colo.—The bids for paving Nineteenth St. with asphalt were as follows: Blake Asphalt Co., paving, $3.05 per sq. yd.; 21 and 24-in. curbing, $1.18 and $1.31 per lin. ft., respectively; total, $48,924; Colorado Paving Co., paving, $2.97; 21 and 24-in. curbing, 75 cts. and 85 cts.; total, $45,588. The engineer's estimate was $51,010, as stated last week.

BRICK PAVING.—Peoria, Ill.—The following bids were opened Oct. 10 for paving Depot St. with one course of small brick on 6 ins. gravel concrete: Robert Clark, 25 cts. per cu. yd. for excavation and $1.75 per sq. yd. for paving; Geo. F. Wightman, 25 cts. and $1.80; P. W. Harmon, 30 cts. and $1.90; W. M. Allen, 20 cts. and $1.52; contract not awarded. The contract for paving Prairie St. with one course of large brick on 5 ins. gravel was awarded to N. Becker, at 24 cts. and $1.49, respectively; P. W. Harmon bidding 30 cts. and $1.56. The bidders were all residents of Peoria. Jacob A. Harman, Cy. Engr.

Altoona, Pa.—Two contracts for paving with vitrified brick have been awarded to Pennock & Vipond, at $2.50 per sq. yd.

LEVEE WORK.—New Orleans, La.—The following lowest bids have been received by Capt. Millis, U. S. Engineer Office, for work in the Atchafalaya district: G. W. Reagan, Torras levee, 14,000 cu. yds. embankment and 100 cu. yds. ditch excavation, 12.5 cts. and 15 cts. per cu. yd., respectively; R. M. Quigley, Popular Grove levee, 79,000 cu. yds. and 700 cu. yds., 11.7 cts. each; John Scott & Sons, Anchorage levee, 53,000 cu. yds. and 500 cu. yds.; Port Allen levee, 92,000 cu. yds. and 760 cu. yds.; Nereaux levee, 85,000 cu. yds. and 450 cu. yds.; St. Louis levee, 24,000 cu. yds. and 400 cu. yds., all at 12.93 cts. and 10 cts., respectively; John Appel, Homestead levee, 11,000 cu. yds. and 500 cu. yds., 11.75 cts. each.——Lafourche district: Garbish & O'Neil, Videl levee, 40,000 cu. yds., 13⅜ cts.; E. T. Martin & Co., Hard Times (Wilson) levee, 50,000 cu. yds., 18.73 cts.; L. M. Dalgarn, Glasscock's levee, 15,000 cu. yds., 19 cts.

Alexandria, La.—The Red River, Atchafalaya and Bayou Boeuf levee board has awarded the following contracts: Hudsons, Rapides, to Wm. Robson, 125,000 cu. yds., at 14 cts.; Tramway to Connella, Rapides, M. L. Lanan, 40,000 cu. yds., at 13.5 cts.; Rogers', Rapides, B. L. Lewis & Co., 30,000 cu. yds., at 13.3 cts.; Bayou Canal, Avoyelles, R. Coco, 12,000 cu. yds., at 20 cts.; Delano, St. Landry, to Hayes Bros., 25,000 cu. yds., at 14 cts.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

GAS LIGHTING.—Allegheny, Pa.—The contract for gas for public lamps has been awarded to the Allegheny Gas Co., at 55 cts. per 1,000 cu. ft.

WATER POWER.—Rat Portage, Ont.—The construction of the Tunnell Island water power plant will soon be commenced, according to reports.

DREDGING.—Galveston, Tex.—Bids will be received at the U. S. Engineer Office until Nov. 6 for dredging in Cedar Bayou, Tex. Maj. A. M. Miller, U. S. A.

COURT HOUSE.—Spokane, Wash.—It has been about decided to sell $250,000 of county bonds and to construct the foundation of the proposed courthouse this winter.

BUILDING WORK.—Victoria, B. C.—Bids are asked until Nov. 30 for the following work for the new parliament buildings at James Bay: Excavator, mason and bricklayer's work; carpenter and joiner's work; slater's and plasterer's work; coppersmith's work; smith and ironfounder's work; plumber's work; painter's work. W. S. Gore, Dep. Comr. Wks.

BREAKWATER.—Portland, Me.—Bids will be received at the U. S. Engineer Office until Oct. 31 for a stone breakwater near Bar Harbor. Lieut.-Col. Peter C. Hains, U. S. A.

WHARVES.—Toronto, Ont.—The board of public works has adopted plans for two wharves. About $25,000 worth of cribwork will be required for one and the work will probably be done at once. The other will cost more and may not be constructed this season.

CHANNEL IMPROVEMENTS.—Albany, N. Y.—Bids are asked until Oct. 26 for improving the channel of Butternut Creek, the work including 27,000 cu. yds. of excavation. Edward Hannan, Supt. Pub. Wks. Specifications on file at office of J. H. Flanagan, Asst. Supt. Pub. Wks., Syracuse.

RIPRAPPING.—Los Angeles, Cal.—The following bids have been received for riprapping along the river front, the work requiring about 1,000 lin.' ft. of stone and 10,000 cu. yds. of earth: M. Zuretti, $10,995; Bright & Crandall, $12,099; Grant Bros., $12,749; M. H. French, $9,470; F. T. Perris, Southern California Ry. Co., $6,983.

GUNBOATS.—Washington, D. C.—The following bids were opened Oct. 17 for the construction, according to specifications, of three light draft gunboats, numbered 7, 8 and 9, the cost of each of which is limited to $400,000, exclusive of armor and premiums:

Maryland Steel Co., Baltimore, gunboat No. 7, $380,000; either 8 or 9, $380,000; 7 and either 8 or 9, $758,000; 8 and 9, $750,000; all three, $1,110,000.

John H. Dialogue & Son, Camden, N. J., all three, $1,186,000.

Union Iron Works, San Francisco, 7, $400,000; either 8 or 9, $385,000; 7 and either 8 or 9, $785,000; 8 and 9, $700,000; all three, $1,100,000.

Coronado Foundry & Machine Co., Coronado, Cal., 7, $372,000.

Bath Iron Works, Bath, Me., 7, $425,000; either 8 or 9, $468,000.

Newport News Shipbuilding & Drydock Co., Newport News, Va., 7, $290,000; either 8 or 9, $306,000; 7 and either 8 or 9, $585,000; 8 and 9, $575,000; all three, $840,000.

Bids for construction under plans of the bidder were submitted as follows:

Union Iron Works, 8 or 9, $377,000; both, $684.000; all three, $1,084,000.

Bath Iron Works, 7, $368,000; 8 or 9, $382,000; both, $754,000.

GARBAGE CREMATOR.—Chicago, Ill.—The following bids were received Oct. 13 for a garbage cremator:

American Garbage Crematory Co., Chicago, furnace with a capacity of 150 tons of garbage each 24 hours, $15,000; if operated by the company, 65 cts. per ton.

Chicago Crematory Co., 120-ton furnace at $125 for each ton of garbage consumed in a 24-hour test. It will itself burn garbage unmixed with ashes at 85 cts. per ton and 10 cts. per ton extra for each 10% of ashes.

Chemical Garbage Reduction Co., 100-ton furnace, $25,000, or it will burn garbage at 70 cts. per ton.

F. N. Cline, furnace with a capacity of 100 tons each 12 hours, for $9,350, or he will burn garbage at 75 cts. per ton if given 100 tons per day, ashes and garbage mixed.

Engle Sanitary & Cremation Co., garbage and ashes mixed, not over 33% of ashes, capacity of 100 tons, at $16,500 or $18,000, according to the kind of fuel to be used. A 40-ton furnace, $10,000.

American Garbage Crematory Co., Boston, furnace of 80 tons capacity in 12 hours, or 102 tons in 24 hours, $16,000.

Johnson Furnace Co., Chicago, furnace of 300 or 400 tons capacity, $25,000. It will burn garbage for 40 cts. per ton.

Sanitary Product Co., Philadelphia, furnace of 175 tons capacity, $60,000, and if the city operates the furnace it wants 50 cts. a ton royalty.

Economic Sanitary Co., Helena, Mont., 150-ton furnace, $25,000.

Rider Garbage Furnace Co., Pittsburg, offers to burn garbage for ten years at 88 cts. a ton. It asks $10,000 for the furnace.

W. H. Garretson, St. Louis, ten furnaces, 75 cu. yds. capacity each, for $100,000, or one for $11,000 and additional ones at $10,000 each; if operated by himself, 12½ cts. a cu. yd. for burning garbage.

INDUSTRIAL NOTES.

THE ROGERS LOCOMOTIVE CO., Paterson, N. J., is building two mogul engines, with cylinders 14 × 20 ins., for the Santa Fe Ry., of the Argentine Republic. The tenders are of the English type, with plate frames, six wheels and rigid wheelbase.

THE BUFFALO CAR CO., Buffalo, N. Y., is building 200 gondola cars of 60,000 lbs. capacity, for the Goodyear Lumber Co., to be used on the Sinnemahoning Valley R. R.

THE MOUNT VERNON CAR CO., Mt. Vernon, Ill., is building 300 fruit cars for the Florida Central & Peninsular R. R.

THE ASHTON VALVE CO., of Boston, Mass., has applied the Ashton lock-up pop safety valves to 29 of the 52 water tube boilers of the main power plant, at the Columbian Exposition, including 12 Heine boilers, 9 Campbell & Zell boilers, 4 Gill (Stearns) boilers and 4 National boilers. These boilers represent 11,250 HP., and have in all 64 valves, ranging in size from 3½ to 5½ ins.

THE PELTON WATER WHEEL CO., of San Francisco, has recently sent a power plant to Mexico which has in it some novel features. The plant embraces two 67-in. three-nozzle Pelton wheels, having a capacity of 700 HP., running under a head of 100 ft. This station is intended to operate a jute factory located at Barrio-Nuevo, in the state of Orizaba, some 60 miles inland from the port of Vera Cruz. These wheels are to be connected to four electric generators and the power will be transmitted to the factory 1¼ miles distant. No line or counter shafts are to be used in the factory but every machine will be run by a separate motor varying from 1 to 20 HP. as required. Pelton regulators are attached to the wheels which will give a uniform speed under all variations of load. This is another of the now rapidly increasing examples of the substitution of electric power transmission for the shafting pulleys and belting which have been so long in use.